FOREST PEST CONDITIONS IN WISCONSIN

ANNUAL REPORT 1971

DEPARTMENT OF NATURAL RESOURCES
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FOREST PEST CONDITIONS
IN WISCONSIN
ANNUAL REPORT - 1971

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DEPARTMENT OF NATURAL RESOURCES
Division of Forestry, Wildlife
and Recreation
Bureau of Forest Management

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PREFACE

This report is a compilation of information received from a variety of sources. It is based largely on seasonal reports from field pest survey and control personnel and their annual reports. These are supplemented by information on forest pest conditions received from cooperating field personnel in our own and other agencies.

"Thank you" to all who have contributed in any way to the content of this 1971 report.

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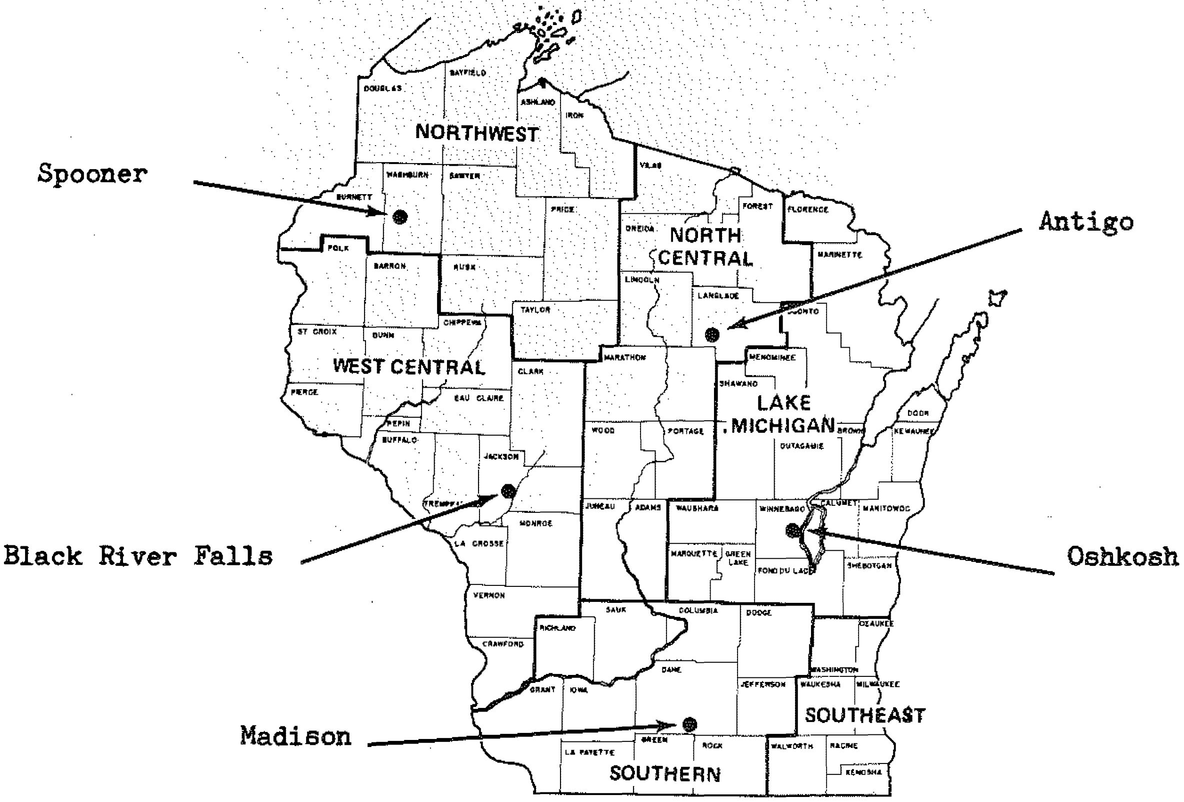
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Highlights of Forest Pest Conditions - 1971

-- Early jack-pine budworm larval populations were high in parts of Bayfield, Burnett, Douglas and Polk counties. Defoliation ranged from light to heavy over a gross area of 80,000 acres but no top-killing or tree mortality resulted. Budworm populations dropped in Marinette, Oneida and Vilas counties and remained low elsewhere.

-- A spruce budworm outbreak continued on 6,500 acres of industrial forest land in Oneida County, and another was reported on 200 acres of spruce plantation in Forest County.

-- High mortality of overwintering pine tussock moth larvae again reduced the potential for serious defoliation of jack pine in a perennial area of infestation along the Douglas - Washburn County line.

-- Lepidopterous oak defoliators including variable oak leaf caterpillar, red-humped oakworm and orange-humped mapleworm were active in several small widely scattered areas.

-- The birch skeletonizer was active over most of the state, but was unusually abundant in Forest, Langlade, Oneida and Vilas counties.

-- The first free-flying gypsy moth to be caught in Wisconsin was found in a trap at Mill Bluff Roadside Park on August 19.

-- The pine root weevil continues to be a serious pest in commercial jack and red pine plantations in west central Wisconsin.

-- Introduced pine sawflies caused severe defoliation of white pine in Burnett and Washburn counties. They were reported from as far east as the Kettle Moraine State Forest in eastern Fond du Lac County.

-- Defoliation of jack pine by the red pine sawfly was extensive in southeastern Wood County and adjoining townships in northern Adams County.

-- Dutch elm disease has continued to spread and is now present in 63 of Wisconsin's 72 counties. Presence of the disease in forested areas is forcing some timber owners to alter management practices.

-- Widespread dying of butternut in southwestern Wisconsin appears to be caused by the fungus Melanconis juglandis. Verification is in process at the University of Wisconsin.

-- Brown spot needle blight, now known to be present in 18 counties, was found for the first time in Pepin and Wood counties in 1971. Bordeaux mixture has been effective in controlling the disease.

-- White pine needle blight was not as severe or widespread as in 1970. White pine, sensitive tobacco, rubber strips and a sulfur dioxide meter are being used to monitor atmospheric pollutants.

Highlights (Continued)

-- An unknown die-up and tip blight of red pine was observed in several areas in Vilas County. Lower branches of affected trees die prematurely and current year's shoots are sometimes killed.

-- The fungus, Armillaria mellea, is the cause of mortality to young red and white pine where overstory oak has been killed following repeated insect attacks, or where herbicides have been applied to release the pines. This type of mortality has been noted in Bayfield, Douglas, Marinette, Menominee and Washburn counties.

-- Hemlock mortality, believed to be caused by a combination of factors, appears to be increasing in Menominee County.

MAJOR FOREST INSECTS

COLEOPTERA

Bronze Birch Borer - Agrilus anxius Gory

Shade and ornamental white birch were again plagued by this insect in the Northwest. Some twig mortality occurred but adequate moisture appeared to minimize the impact of the borer.

Two-Lined Chestnut Borer - Agrilus bilineatus (Weber)

Top-killing and mortality of northern pin oak (Quercus ellipsoidalis E. J. Hill) followed increased activity by the borer in Clark, Jackson, Juneau and Monroe counties. Trees were predisposed to borer attack by the dry summer of 1970 and heavy spring frosts in 1970 and 1971 which weakened the trees.

Mortality of northern pin oak continued at a slow rate in parts of Menominee County, including parts of several sections in T29N, R16E and T28N, R15E where the chestnut borer had been active in the period 1964-1966 (Figure 13B).

Elm Flea Beetle - Altica carinata (Germar)

Moderate defoliation was observed in scattered patches of elm in Langlade, Lincoln, Marathon, Menominee and Shawano counties. Foliage, riddled with holes by mid-July, caused anxiety to some people whose trees were affected.

Aspen Leaf Beetle - Chrysomela sp.

Larvae were common in aspen stands of Lincoln, Oneida and Vilas counties during mid-June, but defoliation was light in most areas that were observed.

Pales Weevil - Hylobius pales (Herbst)

Considerable flagging caused by weevil feeding occurred in a 20-acre red pine Christmas tree plantation in LaCrosse County (Section 1, T18N, R6W). Populations increased during 1970 on the untreated stumps of trees cut in 1969. Feeding in the fall of 1970 and in the spring of 1971 caused flagging which became noticeable in 1971. Populations appeared to decline in 1971 as little adult feeding was observed in October.

Pine Root Collar Weevil - Hylobius radicis Buchanan

No new areas of infestation were reported in the northwest counties during the year. Some flagging was observed in areas of known infestations in Burnett, Sawyer and Washburn counties. In the North Central District, 2% of the trees were killed in a Scotch pine plantation in Marathon County (Section 26, T26N, R7E). More severe attacks were observed in Portage County in abandoned Scotch pine Christmas tree plantations where tree mortality has been occurring for several years.

Two new infestations of the weevil in Scotch pine were investigated in the West Central District. An infestation involving 3 acres of Christmas trees in Jackson County (Section 16, T21N, R5W) and another of 15 acres in Monroe County (Section 30, T19N, R1E) were reported. Inquiries for treatment recommendations indicate that root collar weevil is widely recognized and routinely controlled by most Christmas tree growers. Limited availability of benzene hexachloride has prompted substitution of inadequately tested chemicals for weevil control.

Population levels were high in the sand counties of Marquette, Waushara and Waupaca in the Lake Michigan District.

Phenological Note:

June 18 - Larvae were active in the root collar zone on Scotch pine in Marathon and Portage counties.

Pine Root Weevil - Hylobius rhizophagus Millers

No new areas of infestation were found or reported in the Northwest District, but flagging and tree mortality did occur in areas of known infestations in Burnett and Washburn counties.

The weevil was a continuing problem in commercial jack and red pine plantations in the West Central District. Considerable flagging in red pine adjacent to infested jack pine occurred in Jackson County Iron Company (formerly Jackson County Forest) plantations in Section 6, T21N, R3W; and in Black River State Forest plantations in NW¼ Section 27, T22N, R3W. Approximately 29 acres of mixed red and jack pine plantations are to be cut in Section 24, T22N, R3W of the Black River State Forest because the weevil killed much of the jack pine and top-killed the red pine. Cruise data indicates that about 20% of the jack pine stems died within the last 5 years from weevil damage.

No new infestations were found or reported in the Lake Michigan District. Weevil activity was confined to previously reported sites.

Native Elm Bark Beetle - Hylurgopinus rufipes (Eichhoff)

Intensive sampling for the beetle was discontinued during the 1971 growing season in Menominee County. Casual observations indicated a decline in numbers of emergence exits from one-year-old slash.

All elm bark beetles and galleries that have been checked in West Central counties (including those in Section 15, T27N, R10W, Eau Claire County) have been those of the native elm bark beetles. However, few inspections have been made in the West Central District.

The native elm bark beetle was more common than the European elm bark beetle (Scolytus multistriatus Marsham) in the Lake Michigan District where attacked trees showed no symptoms of Dutch elm disease but were generally in poor condition.

Pine Bark Beetles - *Ips* spp.

High bark beetle populations built up in slash from several red pine plantation thinnings in Douglas County. However, adequate moisture apparently kept the fall generation from invading living trees in the plantations. A 35-year-old jack pine plantation in Bayfield County (Section 14, T48N, R8W) had some tree mortality due to bark beetle activity.

Bark beetles were not as troublesome in the North Central District as in 1970. One plantation problem in the Marathon County Forest was attributed to drought and bark beetles. About five acres of the fifty-acre red pine planting had been row-thinned in 1968. Ten trees were killed in 1969 and more than twenty died in 1971. Adults of *Dendroctonus valens* LeConte and pales weevil larvae were present at the bases of recently killed trees.

Soil profiles were dug in both the thinned and unthinned areas the day after a heavy rain. Soil moisture in the thinned stand ~~was visi~~bly-apparent to a depth of more than 24 inches, whereas, soil in the unthinned area was extremely dry 12 inches beneath the surface.

Bark beetles caused little damage in the West Central District. High moisture levels during the spring and adequate late summer rains reduced bark beetle hazards. A few infestations, not discovered by landowners until 1971, were associated with 1970 summer cutting projects or trees weakened by unfavorable conditions.

High populations of beetles were found in isolated trees in Marinette, Oconto, and Waushara counties in the Lake Michigan District.

Red pine continued to die in numerous windbreaks in the sandy areas north of Sauk City in Sauk County (Southern District).

Phenological Note:

July 8 - Adults were active in galleries; females were ovipositing, and some older galleries contained larvae in Marathon County jack pine.

Hickory Borer - *Megacyllene caryae* Gahan

Specimens were found in shagbark hickory in Winnebago County where they were found feeding in association with the banded hickory borer, *Cerasphorus cinctus* Drury.

White Grubs - *Phyllophaga* spp.

Adult beetles were numerous in parts of the Northwest District and defoliation of oak and aspen was reported. The flight period started about May 15 and extended through most of June. One small red pine planting in Douglas County (Section 2, T44N, R12W) sustained about 50% mortality attributed to root damage by grubs.

No significant grub damage was reported in young plantations in the West Central District. Tree loss was less than 2% in the Eau Claire County Forest plantation (Section 14, T26N, R5W) where more than 10% loss from grubs occurred in 1970.

Adult beetles were observed everywhere in the Lake Michigan District, but at no time were they as numerous as P. drakii Kearby was in Waupaca in 1970.

Northern Pine Weevil - Pissodes approximatus Hopkins

A few trees were attacked and killed by the weevil in Washburn County, Northwest District (Section 14, T42N, R12W).

White Pine Weevil - Pissodes strobi (Peck)

Weevil populations were extremely low throughout the Northwest District in 1971, and no significant infestations were reported in the North Central District.

Damage appeared to be less than in 1970 in white pine plantations in the West Central District although no quantitative evaluations were made. Ornamental blue spruce were damaged in Black River Falls (Jackson County). Damage in 1970 led some Christmas tree growers to request control recommendations early in 1971. A shortage of lindane and benzene hexachloride (BHC) led to substitution of methoxychlor for some treatments. In a Norway spruce plantation (Section 21, T22N, R4W) where methoxychlor was used as a 0.5% spray, post treatment infestation was 5%, and in blue spruce 1.7% of the leaders were infested.

Weevils were endemic over the Lake Michigan District. Planting of white pine in the open has largely been discontinued. Some stands on state land, with trees approaching the 20-foot height, have in excess of 400 straight trees per acre.

A Weevil - Sciaphilus asperatus (Donsel)

This insect was first noted in Wisconsin in 1961. Specimens were identified that year by the U. S. National Museum. It has been abundant in localized areas several times since then. Heavy infestations were reported again in 1971 in hardwood stands throughout Forest, Langlade and Menominee Counties. Defoliation was heavy on very small reproduction and other ground vegetation.

Adult beetles were observed feeding on leaves of hard maple reproduction and continued to be active until freeze-up in Langlade County.

DIPTERA

Balsam Gall Midge - Dasineura balsamicola (Lintner)

A moderate infestation continued during 1971 in a natural balsam stand in Washburn County (Sections 14 and 15, T38N, R13W). Evidence of the insect was observed on scattered trees in Marinette and Shawano counties.

Severe infestations occurred in balsam fir Christmas tree plantings in Langlade County. A few attempts at control by mistblower application of malathion at a rate of 1/2 pound active ingredient per acre were only partially successful because of high winds, rain and cold temperatures which prevailed during the prime treatment period.

Phenological Notes:

May 10 - Balsam buds were just starting to open on a few trees on a south slope in a Langlade County Christmas tree stand. No adult midges were observed.

May 16 - No adults emerged to date in traps. Partial bud break had occurred in most trees. Simulids, present by the thousands, were biting hard.

June 1 - New shoot elongation averaged 3/4 inch. Newly forming galls were faintly visible on new needles. Apertures in the galls and minute larvae were visible with the aid of a microscope. Buds were less than 1/2 inch long on Fraser fir growing in the vicinity.

Onion Maggot - *Hylemyia antiqua* (Meigen)

Large numbers of dead adult flies were observed clinging to needles of pines growing near agricultural areas in the Lake Michigan District.

Red Pine Needle Midge - *Thecodiplosis piniresinosae* Kearby

Very light infestations were scattered in red pines in parts of Washburn County. No infestations were reported or observed in the West Central District or elsewhere in the state.

HOMOPTERA

Pine Spittlebug - *Aphrophora parallela (Say)*

Spittle masses were commonly observed in most jack pine stands in the Northwest District but no heavy infestations of spittlebug were found or reported.

Spittle masses were also noted on much of the Scotch pine and jack pine in the North Central and Lake Michigan Districts. A severe infestation on Scotch pine in a thirty-five acre plantation in Shawano County (SE¼NE¼, Section 8, T28N, R12E) was treated with malathion, at the rate of 1/2 pound active ingredient in one gallon of #2 fuel oil per acre, on July 10, when most of the spittlebugs had reached the adult stage. Spittle masses had numbered more than 100 per tree in the six- to eight-foot-tall trees.

Populations in the West Central District were much lower than those of the previous two years. No damage was reported there.

Phenological Notes:

June 1 - Spittlebug nymphs were in the second instar in Shawano County.

June 18 - Nymphs were in the last instar in Adams and Jackson counties.

June 26 - Nymphs were in the fourth instar in Shawano County.

Saratoga Spittlebug - Aphrophora saratogensis (Fitch)

Populations varied from light to heavy in red pine plantations in the north central counties. A low volume application of malathion at the rate of 3/8 pound active ingredient per 1/2 gallon of No. 2 fuel oil per acre was used to treat 145 acres of pine plantations on the American Legion and Northern Highland State Forests. An additional 225 acres were treated with malathion by private landowners (Table 1).

Table 1. Red Pine Plantation Acreage Treated with Malathion to Suppress Saratoga Spittlebug - 1971.

Treated Unit	County	Legal Description	Acres Treated
Northern Highland State Forest	Vilas	Sec. 35 & 36, T43N, R7E	23
American Legion State Forest	Vilas	Sec. 3 & 10, T39N, R8E	65
		Sec. 15, T39N, R9E	38
		Sec. 14, T38N, R9E	19
Industrial Forest	Oneida	Sec. 17, T38N, R5E	100
Private Plantations	Oneida	SE¼ SW¼ Sec. 6, T39N, R7E NE¼ NW¼ Sec. 7, T39N, R7E	80
	Vilas	NE¼ SE¼ Sec. 36, T40N, R6E	40
		Total Acres Treated	365

Saratoga spittlebug populations were low elsewhere in the state except in Marinette County where several plantations were kept under surveillance. High counts of spittlebug adults were made on June 23 on trees in the following legal descriptions in Marinette County: W½ SW¼ Section 32, T35N, R20E; Sections 27 and 33, T35N, R21E; Section 4, T34N, R21E; SE¼ SE¼ Sections 1 and 7, and NW¼ SW¼ Section 8, T34N, R18E; SE¼ SE¼ Section 17, T34N, R19E. Favorable stand conditions indicated that the trees would be able to tolerate the populations observed, and none of the plantations were treated.

Cicada - species unknown

Thousands of cicadas were observed on June 18 in a twenty-acre aspen stand in the Marathon County Forest. Oviposition was extremely heavy on hardwood vegetation and much twig mortality is expected.

Oak Lecanium - Lecanium quercifex Fitch

This scale caused noticeable twig mortality on scrub oak (Quercus ellipsoidalis E. J. Hill) in parts of Washburn County (T42N, R13W) and Douglas County (T43N, R11, 12, 13W).

Balsam Twig Aphid - Mindarus abietinus (Koch)

Twenty to fifty percent of the shoots were infested in many balsam fir plantings in Langlade, Lincoln and Oneida counties. Nymphs were numerous in curled new shoots on June 1 when the new growth averaged 3/4-inch in length.

Some balsam fir Christmas tree plantations were damaged by the aphid in the West Central District in 1971. Chemicals were used to prevent severe damage in two plantations. In Monroe County (Section 35, T18N, R2W), Meta Systox-R and malathion were applied by a mistblower on May 15 - 17, after large numbers of young aphids were found on May 11 in expanding buds with only 1/4 inch of green needle growth exposed. The malathion was applied at 1½ to 2 pounds active ingredient per acre with a tractor-mounted high-volume Bean mistblower. The second area treated was about 6 acres of fir plantation in Clark County (Section 8, T24N, R4W). Here the heavily infested trees were sprayed with malathion on May 27 and again on June 9.

When evaluated on June 15, masses of dead aphids were found on many twigs. Occasional colonies of live aphids were found on 50% of the trees. However, over 95% of the inspected twigs were without live aphids.

Thiodan and Ethion 67 in oil, applied in aphid control tests using a pressure sprayer in the Clark County plantation on June 3, produced excellent results.

Pine Bark Aphid - Pineus strobi (Hartig)

A few heavy infestations were reported on shade and ornamental white pine in the Northwest District. Infested white pines were well distributed throughout the Lake Michigan District where severity varied from tree to tree. Populations remained low in Hayward Nursery, and other state nurseries where lindane has been used sparingly, when necessary, with good results. No more than one application has been necessary in a growing season.

There has been no evidence that infestations on planting stock in past years have persisted or caused tree losses after the trees had been out-planted. Infestations in stands of older trees flare up occasionally causing the smooth-barked stems of some trees to appear white-washed, but these vary from year to year depending on occurrence of favorable conditions for the insect. No losses of plantation white pine or natural trees, attributable to bark louse, have been observed in Wisconsin for a period of more than 15 years.

HOMOPTERA

Pine Tortoise Scale - Tuomeyella numismaticum (Pettit & McDaniel)

Single infested trees and small groups of infested jack pine and red pine were observed at widespread points around the state. The largest severe infestations covered about one-half acre of jack pine, 3 - 15' tall, in each of two locations in Sections 6 and 35, T22N, R3W in Jackson County. Scotch pine Christmas trees were infested in Section 1, T33N, R10E in Langlade County.

Scattered individual infested jack and Scotch pines were reported in two plantations in southern Sawyer County, and from the southern part of Marinette County.

HYMENOPTERA

Introduced Pine Sawfly - Diprion similis (Hartig)

Spring populations were moderately heavy on many white pines in the Northwest District. Fall populations were also high in parts of Burnett and Washburn counties. In the absence of heavy frosts larvae fed well into October and completed their cycle. Many open-grown and ornamental white pines were severely defoliated and some branch and tree mortality is anticipated.

Populations were light in Lincoln, Oneida and Vilas counties. Adults were observed ovipositing and larvae ranging from first to fourth instars were noted in Vilas County on June 28.

No severe defoliation of white pine was observed in the west central counties where populations were generally low. Virtually 100% winter predation of cocoons by woodpeckers occurred in northern Waupaca County and the northwest corner of Waushara County in localities where elms that had been heavily attacked by elm bark beetles were coincident with high populations of the sawfly.

Elm Leaf Miner - Fenusa ulmi Sundevall

Severe browning of the leaves of elms growing singly or in small groups occurred in Langlade, Lincoln, Marathon and Shawano counties. Larvae were mining leaves on June 18 in central Marathon County and the leaves on many small groups of elms were completely brown.

Striped Alder Sawfly - Hemichroa crocea (Fourcroy)

Defoliation of alder and birch occurred in 1971 in the same area in Douglas County (Section 25, T44N, R10W) where severe defoliation had occurred in 1970. However, defoliation was less severe than in 1970 and the area of infestation had not expanded.

Red-Headed Pine Sawfly - Neodiprion lecontei (Fitch)

Colonies of this sawfly were again numerous on scattered red and jack pines, and their presence on ornamentals prompted numerous requests for control recommendations in the Northwest District. No extensive areas of defoliation were found in the district, but individual trees will have branch mortality or top-killing.

A few scattered heavy infestations were reported in Langlade and Oneida counties on red pine ranging in size from 4 to 10 feet tall, but generally populations were much lighter in those counties than they were in 1970.

Populations were low in the west central counties and the sawfly was seldom observed. The only observation of more than single colonies in that part of the state was in Eau Claire County (Section 9, T26N, R6W) where six colonies were observed on July 14.

Only occasional colonies were noted in Marinette, Shawano and Waupaca counties during the season.

Jack Pine Sawfly - Neodiprion pratti banksianae Rohwer

As in past years, a few scattered colonies were found in jack pine stands in Douglas County (T44N, R11W and T45N, R10W). The insect was found in association with Neodiprion nanulus nanulus Schedl in an infestation covering several sections in Adams and Wood counties.

Red Pine Sawfly - Neodiprion nanulus nanulus Schedl

Tentative identification of larvae by a specialist indicated that this sawfly was a major contributor to extensive defoliation covering several sections of jack and red pine in central Wisconsin. Defoliation of jack pine ranging from 50% to 90% occurred over much of T20N, R5, 6E in Adams County and in T21N, R6E in Wood County. Only old foliage was consumed. Little defoliation was apparent on red pine. Most larvae were in the 5th instar when observed on June 8 and nearly all had pupated by June 18. Adults were observed on September 14 in Section 26, T26N, R6E.

Larch Sawfly - Pristophora erichsonii (Hartig)

Most tamarack stands in the Northwest District showed signs of some defoliation again in 1971, and many scattered stands were severely defoliated throughout the district.

Most tamarack stands in the northern counties of the North Central District were severely defoliated and only a few stands had foliage remaining by early August. On June 28 adults, 2nd instar larvae, mature larvae and eggs were all observed on the same tree at Trout Lake in Vilas County (Section 10, T41N, R7E). Trees at this location were only lightly infested. On the same day only eggs were found on trees examined in Oneida County (Section 20, T36N, R11E). On July 28 moderate to heavy defoliation was apparent in the same counties and larvae were near mature.

Defoliation was light to medium in tamarack stands in Clark and Jackson counties.

Defoliation was extremely variable in the east central counties ranging from light to severe. In some instances feeding appeared to have been arrested because of predation. Oviposition scars were frequently found with a limited amount of feeding adjacent to them and no larvae were present.

Hornets and Yellow Jackets - Vespa spp.

These insects were very numerous in the Lake Michigan District in 1971.

LEPIDOPTERA

Pink-Striped Oak Worm - Anisota virginiensis (Drury)

The infestation in Douglas County collapsed completely after three years of severe defoliation. No adults, eggs or larvae could be found during the growing season.

Oak Webworm - *Archips fervidanus* (Clemens)

Colonies of larvae were less numerous than in 1970, but could be found throughout the scrub oak type (*Quercus ellipsoidalis* E. J. Hill) in Burnett, Douglas and Washburn counties.

Oak Skeletonizer - *Bucculatrix ainsliella* Murtfeldt

No significant browning of oaks by skeletonizers was reported in 1971. Occasionally signs of the insects were observed.

Birch Skeletonizer - *Buccalatrix canadensisella* Chambers

Most white birch stands in the northern half of the state were heavily infested in 1971. From Jackson and Waupaca counties northward to the Wisconsin-Michigan border, premature browning of foliage was becoming apparent by mid-August. By the end of August most white birch trees in those counties had lost their leaves. The air was filled with larvae "ballooning" from the trees in Forest, Langlade, Oneida and Vilas counties on September 8.

The skeletonizer was also active in birch stands in counties to the south and west but defoliation was generally less severe and more erratic in distribution.

Large Aspen Tortrix - *Choristoneura conflictana* (Walker)

Populations were light throughout the Northwest District. Infestations collapsed in Forest, Langlade, Lincoln and Oconto counties in the North Central District where only small scattered patches of heavy defoliation were observed. Heavy infestations caused severe defoliation on much of the aspen in central Menominee County, and large numbers of moths were observed in Marinette County in the Lake Michigan District. In Marinette County pockets of defoliation were small and scattered, and spots of heavy defoliation were often restricted to clones.

Phenological Notes:

June 1 - Leaves of quaking aspen averaged about 1/3 normal size with approximately 25% of the clones still dormant in Oconto County. Most tortrix larvae were in the third instar.

June 8 - Defoliation appears to be much lighter in areas defoliated in 1970 in Forest and Oconto counties. Most larvae in the 5th instar, but about 5% had pupated. Defoliation was between 50% and 70% on 700 acres observed.

June 14 - Leaves of quaking aspen have reached full size, those of bigtooth aspen are about 3/4 full size in Menominee County. Defoliation was about 60% complete on 2,500 acres.

July 7 - Trees defoliated earlier in Menominee County had refoliated. Foliage in crowns appeared sparse but leaves were nearly full size.

Spruce Budworm - Choristoneura fumiferana (Clemens)

Larvae could be found in most spruce-balsam stands in Washburn and Sawyer counties but defoliation generally was very light. An area in Washburn County (Sections 11 and 14, T41N, R12W) of about 600 acres had moderate defoliation for the second consecutive year. Egg surveys indicated little or no increase in populations for 1972 in the area.

An outbreak involving timber on 6,500 acres of industrial forest land in Oneida County in 1970, continued in the same general area in 1971. Defoliation was light to moderate. Little top-killing or tree mortality were observed. Timber in the area of heaviest defoliation in 1970 was being logged rapidly.

A moderate to heavy infestation was also reported on 200 acres of 30 - 35-year-old white spruce in an industrial forest plantation in Forest County (Sections 24 and 28, T37N, R14E).

Apanteles cocoons were abundant in both the Oneida County and Forest County infestation areas. The wasps are expected to reduce budworm populations in these counties in 1972.

Phenological Notes:

June 9 - Numbers of 2nd and 3d instar larvae ranged from 3 to 57 per 100 new shoots sampled on balsam in the Oneida County infestation. New shoots were 1/4 to 2 1/4 inches long. Locations of heaviest larval populations corresponded well with 1970 egg mass counts.

June 11 - In Forest County 22% of larvae were in the 3d instar, 48% in the 4th, and 30% in the 5th. New shoots on spruce averaged 1 1/2 inches in length.

June 17 - In Forest County 20% of larvae were in the 4th instar, 5% in the 3d, 70% in the 5th, and 5% had pupated. Browning of trees was barely perceptible. Defoliation was about 10%. New spruce shoots averaged 2 inches in length.

June 28 - 100% pupation in Oneida County. No larvae or moths observed. Heavy parasitism. Empty webs were full of Apanteles cocoons.

July 22 - Moths were still ovipositing in Forest County. Most samples of six 15-inch needle-bearing-portions of branches had 3 or more egg masses. Approximately 90% of viable eggs had hatched. About 20% of total egg masses observed had been parasitized by Trichogramma. Defoliation about 50% on white spruce.

Jack-Pine Budworm - Choristoneura pinus Freeman

Northwest District

Early larval counts indicated high populations in parts of Polk (T36N, R19 and 20W), Burnett (T39N, R17W and T40N, R17W), Douglas (T43N, R13W; T44N, R10W and 11W; T45N, R10W and 11W), and Bayfield (T45N, R9W; T46N, R9W) counties.

Populations remained extremely low in most of Washburn County. Anticipated severe defoliation did not materialize when an extended period of warm weather in June caused the larvae to mature rapidly without their usual wasteful feeding. Noticeable defoliation occurred over a gross area of 80,000 acres in the district. Some moderate to heavy defoliation did occur but no top killing or tree mortality resulted. Budworm egg counts were high again, but egg parasites were more prevalent than in previous years.

Field tests were conducted with two organophosphate insecticides in Douglas County on June 28. Phosvel and two formulations of Dylox were applied by fixed-wing airplane at intended rates of one pound active ingredient per gallon per acre of each formulation and compound tested. The population reduction by Phosvel, adjusted for natural mortality, was 83%. Dylox 80 SPA (80% Soluble Powder) reduced the budworm population in the test area by 68%, and Dylox ULV provided a reduction of 59.6% using Abbott's formula in computation of control achieved. A more detailed report on the Dylox tests may be found on pages 51 - 53.

North Central District

Budworm populations continued to be low in all jack pine areas previously having severe infestations in parts of Marinette, Oneida and Vilas counties. Although some areas had moderate early larval counts, these were reduced to negligible numbers by late June when late instar larval counts were made. Apanteles cocoons were abundant in budworm webs examined during the survey.

Twenty 1/5-acre impact evaluation plots were set up on 6,000 acres of jack pine type in eastern Vilas County in 1969. The budworm infestation reached its peak in the area that year. Evaluations of jack pine mortality were made on the same plots again in 1971, with the exception of 5 plots which were eliminated in logging operations during the interim. Most damaged and budworm susceptible timber, principally overmature and suppressed trees, had been harvested by 1971. An estimated 50% of the mortality that occurred was due largely to suppression of smaller trees in the understory. In some heavily stocked plantations, with insufficient mortality to harvest, the budworm defoliation may have resulted in a beneficial thinning.

On 20 plots in 1969, 82% of the trees were living, 10% top-killed, and 8% were dead. On 15 of the same plots in 1971, 78% of the trees were living, 9% were top-killed, and 13% were dead.

West Central District

Budworm populations were low in the west central counties. Limited surveys were conducted. Early larval surveys in Wood and Adams counties indicated light to moderate populations (5 to 15 new shoots infested out of 30) of budworm with large numbers of red pine sawfly larvae consuming old foliage. Budworm populations dropped without causing noticeable loss of current year's foliage.

A forester for Nekoosa Edwards Paper Company estimated that recent loss of growing stock, due to insect and disease damage, amounted to 3 cords per acre in several company plantations. The majority of this loss was attributed to jack-pine budworm defoliation that occurred during 1968, 1969 and 1970.

Lake Michigan District

Previous high populations in Marinette County collapsed. Evidence of many Apanteles cocoons was found. Ants (presumably marauders or slave-makers) were so numerous in some jack pine stands that one could not stand still at any spot for more than two minutes.

Phenological Notes:

May 20 - First larvae found in Polk County. Jack pine pollen starting to ripen. New leaders 3" - 8" long.

May 21 - Larvae out of hibernation in Burnett, Washburn and western Douglas County. New leaders 3" - 5" long, staminate flowers still hard and green.

May 24 - Larvae out of hibernation in northern Douglas County and western Bayfield County. Leaders 2" - 3" long, staminate flowers hard and green.

May 26 - Pollen ripe and plentiful in northern Washburn and southern Douglas County.

May 27 - Light populations of budworm were still in the 2nd instar in Jackson County.

June 2 - Pollen ripening and plentiful in northern Douglas County and Bayfield County. Budworm larvae still small 2nd instar and little evidence of feeding.

June 10 - Larvae in 3d and 4th instars in Polk and southern Burnett counties.

June 14 - Larvae 30% 4th instar in Polk and eastern Burnett and western Douglas counties.

June 15 - Jack pine new shoots average 1½" elongation in Oneida County (American Legion State Forest). Staminate flowers scarce. All sample plots indicate light populations. Larval stages: 60% 2nd instar, 40% 3d.

June 18 - Larvae mostly 5th and 6th instars, but one pupa found in Wood County. Shoot elongation averaged 2", early instar larval populations light in Marinette County.

June 23 - About 60% of larvae in 4th and 5th instars in Douglas County.

June 28 - Budworm larvae starting to pupate in Douglas County.

June 29 - Budworm larvae predominantly in 5th instar, and a few 6th instars present in Conover area (Vilas County). Parasitism high by Apanteles.

July 6 - About 65% of larvae pupated in Douglas County.

July 12 - Moths starting to emerge in Douglas and Bayfield counties.

Larch Casebearer - Coleophora laricella (Hubner)

Overwintering larvae were collected on March 10 in Oneida and Forest counties for shipment to U. S. Forest Service entomologists at Moscow, Idaho. Although populations were light, more than 200 larvae were collected within a half hour. Larvae were to be examined as sources of parasites to be released in western infestations. An attempt to collect pupae in early June from one of the areas in Oneida County (McNaughton) was not very productive. Four men were able to collect only 50 pupae during a two-hour period. Apparently predation by birds almost eliminated the casebearers at this collection point.

Phenological Notes:

May 17 - Larch needles were about 1/4" long in Langlade County. Larvae were actively mining needles.

May 26 - Larch needle length varied from 1/2" to 1". Cases examined contained 80% larvae and 20% pupae.

Pine Tussock Moth - Dasychira plagiata (Walker)

The destructive tussock moth outbreak along the Polk-Burnett County line collapsed. Little additional defoliation occurred. Egg counts were extremely low and no further problems are anticipated in that area in 1972.

Anticipated high populations failed to materialize on 3,000 acres of jack pine in Douglas and Washburn counties due to overwintering larval mortality. Some light to moderate defoliation did occur in parts of Section 35, T43N, R13W, and Section 2, T42N, R13W. Egg counts were moderately high again in August, but considerably lower than they were in 1970. Egg parasites were responsible for up to 40% egg mortality. Slight expansion of the boundaries of the infestation to the east, south and west doubled the gross area in which the tussock moth was active, but no serious defoliation is expected in 1972.

A single pine tussock moth larva was found in Jackson County on May 10. It yielded a parasite, Itoplectis conquisitor (Say), on May 27.

Phenological Notes:

April 20 - First larvae out of hibernation and starting to feed in the Wascott area (Douglas County).

April 22 - A few of the larger larvae were out and feeding slowly in Polk and Burnett counties. Small larvae were still in hibernation.

May 10 - Few larvae were in the 3d instar in Wascott area.

May 20 - A majority of the larvae were in the 3d instar in Polk and Burnett counties.

June 4 - Some larvae were in the 4th instar in Douglas County.

June 10 - Larvae ranged from 2nd to 5th instars in Polk and Burnett counties.

July 1 - Larvae were predominantly in the 5th and 6th instars in Douglas County.

July 8 - About 40% of larvae pupated in Douglas County.

July 9 - About 40% of larvae pupated in Polk and Burnett counties.

July 15 - 80% of larvae pupated in Douglas County.

July 19 - Pupation complete and a few adults emerged in Douglas County.

July 27 - First eggs of the year found in Douglas County.

August 18 - Most eggs hatched and larvae starting to feed in Douglas County.

Zimmerman Pine Moth - *Dioryctria zimmermani* (Grote)

The insect was numerous and caused much flagging in scattered areas of Waupaca County on red pine, particularly in Section 15, T21N, R11E. Damage was observed occasionally in Scotch pine Christmas tree plantations in west central counties but populations were low.

Elm Spanworm - *Ennomos subsignarius* (Hubner)

No larvae or adults were found in northern Bayfield County (T48N, R8W and T49N, R7W) where populations had been high in 1969 and declining in 1970. There was no obvious evidence of significant damage to timber by the insect.

Pine Needle Miner - *Exotelia pinifoliella* (Chambers)

Noticeable browning of branch tips due to feeding by this needle miner was common on jack pine in T42N, R13W in Washburn County.

Oak Defoliator Complex -

Variable Oak Leaf Caterpillar - *Heterocampa manteo* (Doubleday)
Red-Humped Oakworm - *Symmerista canicosta* Francelmont
Orange-Humped Maple Worm - *Symmerista leucitys* Francelmont

Northwest District

Severe oak defoliation was caused by the combined efforts of these insects in the following parts of Burnett and Washburn counties: Sections 13 and 33, T40N, R17W; Sections 27 and 34, T40N, R16W; Sections 25, 35, and 36, T40N, R15W; Sections 9, 35, and 36, T39N, R16W; Section 32, T39N, R15W; and Section 17, T39N, R13W.

West Central District

Scattered areas of scrub oaks were defoliated in eastern Jackson County, principally by H. manteo and S. leucitys. The largest single area of defoliation was on the north side of Saddle Mound (T22N, R1W) where oaks were 80% defoliated on more than 1,000 acres.

The Polk County area of maple and other hardwoods (Section 25, T43N, R17W), severely defoliated in 1970, was completely defoliated again in 1971 by S. leucitys in association with H. manteo.

North Central District

A population collapse occurred in two areas that were moderately to heavily infested in Marathon County (Sections 1 and 4, T26N, R5E), Menominee County)T30N, R13E) and Shawano County (T29N, R11E) during 1970. The insect involved was principally S. leucitys. Surveys conducted during late July and August revealed only scattered individual larvae in these counties. On August 30 larvae were in the second instar. Most egg clusters, on the under sides of leaves, were parasitized and parasites were observed leaving the eggs.

Lake Michigan District

Almost complete defoliation of a 55-acre woodlot by S. canicosta occurred in Brown County (NW¼ NW¼ Section 18, T24N, R22E). Large tachinid parasites were reared from pupae. Identification is pending. Larvae were in the last instar on September 13. The following host species were defoliated: white oak, bur oak, maple, elm, basswood, beech and black cherry. An occasional white birch was partially defoliated.

Fall Webworm - Hyphantria cunea (Drury)

Webworms were noted and reported from scattered locations over most of Sawyer and Washburn counties. Cherry and alder were the favored host plants.

Aspen Blotch Miner - Lithocolletis tremuloidiella (Braun)

Heavy infestations caused quaking aspen foliage to become mottled yellow by late July in north central counties. The most severe leaf mining occurred in central and eastern Vilas County.

Eastern Tent Caterpillar - Malacosoma americanum (Fabricius)

Tents were more numerous than they have been the past few years on roadside wild cherry trees in Burnett and Washburn counties. Occasional tents were observed in the West Central District by May 14.

Populations were high in the southern counties, especially in the southwest. Trees most affected were chokecherry, ornamental crabs and unsprayed apple trees. Refoliation was starting about mid-June.

Forest Tent Caterpillar - Malacosoma disstria (Hubner)

Only one small colony of larvae was reported in Bayfield County. No egg masses were found in the vicinity, or elsewhere in the state, during routine egg mass surveys.

Mourning Cloak Butterfly - Nymphalis antiopa (Linnaeus)

Larvae were very numerous in the southern third of the Lake Michigan District. Willow was the principal host plant.

Defoliation of ornamental willow and elms in the North Central District prompted numerous calls for assistance from concerned property owners.

Gypsy Moth - Porthetria dispar (Linnaeus)

The first free-flying gypsy moth to be caught in Wisconsin was found in a trap at Mill Bluff State Park in Monroe County (Section 12, T17N, R1E) on August 19, 1971. The trap was baited with "Disparlure", a synthesized attractant for male moths.

The trap was one of one hundred placed at widely scattered locations around the state as part of a cooperative surveillance program involving the U. S. Department of Agriculture - Animal and Plant Health Inspection Service, the Wisconsin Department of Agriculture, and the Department of Natural Resources (Figure 1).

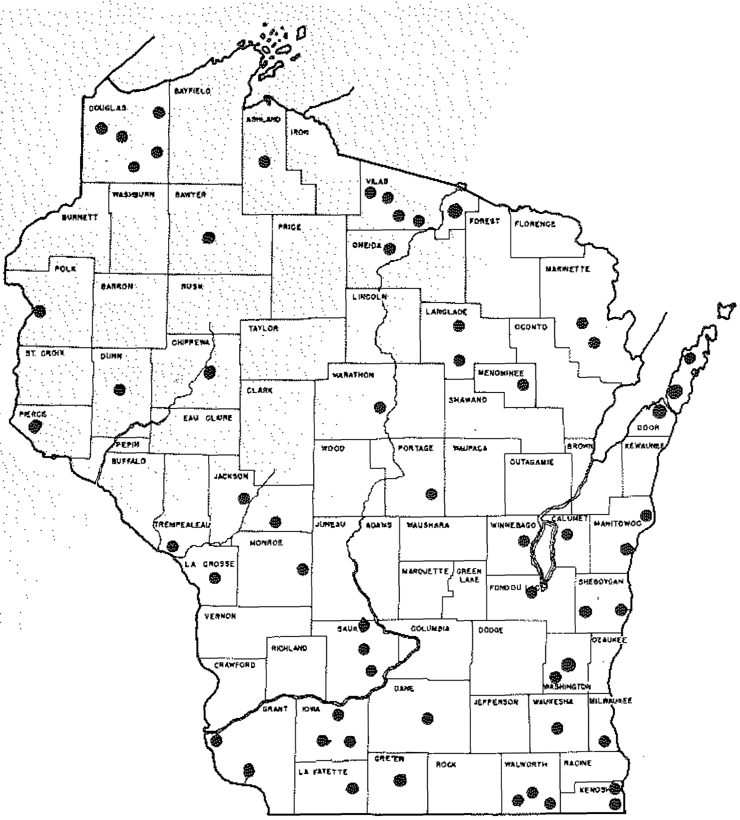

DOUGLAS
BAYFIELD
ASHLAND
IRON
VILAS
WASHBURN
SAWYER
BURNETT
PRICE
ONEIDA
FOREST
FLORENCE
POLK
BARRON
RUSK
LINCOLN
MARINETTE
LANGLADE
OCONTO
TAYLOR
ST. CROIX
DUNN
CHIPPEWA
MARATHON
MENOMINEE
CLARK
SHAWANO
PIERCE
EAU CLAIRE
DOOR
PEPIN
BUFFALO
WOOD
PORTAGE
WAUPACA
BROWN
KEWAUNEE
OUTAGAMIE
JACKSON
TREMPEALEAU
JUNEAU
ADAMS
WAUSHARA
WINNEBAGO
CALUMET
MANITOWOC
MONROE
LA CROSSE
MARQUETTE
GREEN LAKE
FOND DU
SHEBOYGAN
VERNON
SAUK
COLUMBIA
DODGE
OZAUKEE
RICHLAND
CRAWFORD
WASHINGTON
DANE
GRANT
IOWA
JEFFERSON
WAUKESHA
MILWAUKEE
LA FAYETTE
GREEN
ROCK
WALWORTH
RACINE
KENOSHA

Figure 1. Gypsy moth trap locations, Wisconsin - 1971.

An egg mass survey was made at Mill Bluff State Park on October 28. The heavy-use areas of the park were systematically examined by a team of 12 men and no eggs were found. The conclusion reached, after a thorough study of the area, was that the moth was a "hitchhiker" brought to Wisconsin by a park visitor.

The catch at Mill Bluff, and similar catches in other states far-removed from known infestations, indicates the potential for this pest to spread to other parts of the country.

The Mill Bluff Park area will be under close surveillance in 1972 and the state-wide trapping program will likely be expanded.

Bagworm - Thyridopteryx ephemeraeformis (Haworth)

As predicted in the 1970 report bagworms were not able to overwinter on ornamental junipers at the DNR headquarters in Black River Falls (Jackson County). The trees were apparently infested at the time they were received for planting from an out-of-state supplier.

ORTHOPTERA

Walkingstick - Diapheromera femorata (Say)

The only infestations reported were in Marinette County. Walkingsticks and post oak locust, Dentrotettix quercus (Packard) were found feeding together in T31N, R19E and T31N, R20E.

Post Oak Locust - Dendrotettix quercus (Packard)

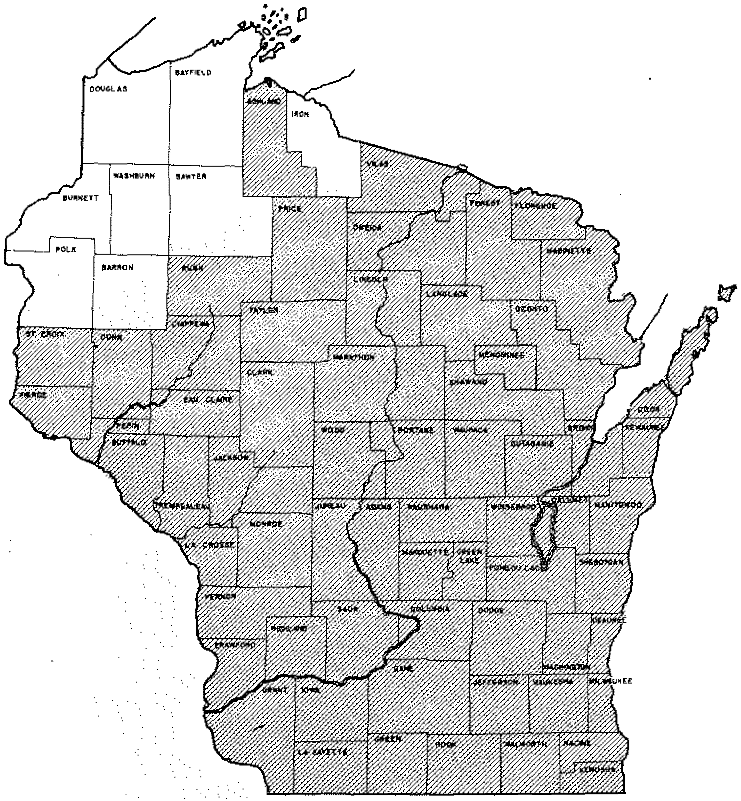
This grasshopper caused defoliation of oak in Jackson County, and was associated with walkingsticks defoliating oaks in Marinette County. Defoliation was most severe in T20N, R3W in Jackson County near Interstate Road 94. Between 50% and 90% of the foliage was removed from the trees in the area. Tree trunks at the I-94 scenic overlook on Bell Mound were reported to be "covered with half-grown grasshoppers" on June 17, 1971. Blue-tailed skinks, (Eumeces fasciatus (Linnaeus), were numerous under the ties which served as stairs, and they darted out frequently to grab young grasshoppers that dropped off the trees.

MAJOR FOREST DISEASES

WILTS AND DIEBACKS

Dutch Elm Disease - Ceratocystis ulmi (Buisman) Moreau

Dutch elm disease has been known to be present in Wisconsin since 1956 and is now found in 64 of Wisconsin's 72 counties (Figure 2). Pepin County was the only new county reported in 1971.


DOUGLAS
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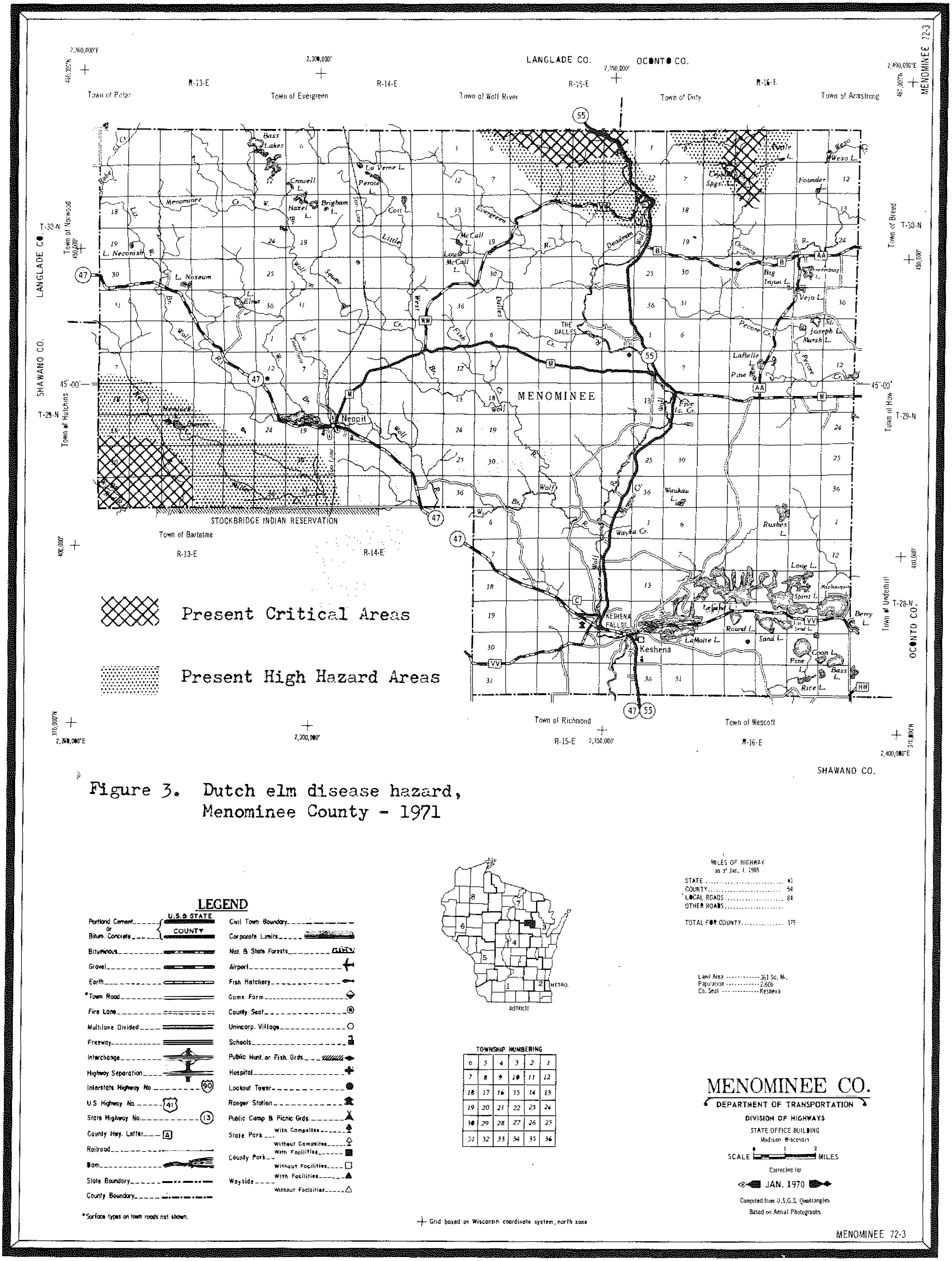
IRON
VILAS
WASHBURN
SAWYER
BURNETT
POLK
BARRON
RUSK
PRICE
ONEIDA
FOREST
FLORENCE
MARINETTE
LINCOLN
LANGLADE
OCONTO
TAYLOR
CHIPPEWA
ST. CROIX
DUNN
MARATHON
MENOMINEE
SHAWANO
CLARK
PIERCE
EAU CLAIRE
PEPIN
BUFFALO
WOOD
PORTAGE
WAUPACA
OUTAGAMIE
BROWN
DOOR
KEWAUNEE
JACKSON
TREMPEALEAU
JUNEAU
ADAMS
WAUSHARA
WINNEBAGO
CALUMET
MANITOWOC
MONROE
LA CROSSE
MARQUETTE
GREEN LAKE
FOND DU LAC
SHEBOYGAN
VERNON
SAUK
COLUMBIA
DODGE
OZAUKEE
RICHLAND
CRAWFORD
DANE
WASHINGTON
JEFFERSON
WAUKESHA
MILWAUKEE
GRANT
IOWA
LA FAYETTE
GREEN
ROCK
WALWORTH
RACINE
KENOSHA

Figure 2. Known distribution of Dutch elm disease in Wisconsin - 1971

Intensification and spread occurred wherever the disease was reported in previous years. The only major northward extension observed was along the Wolf River north of Post Lake into Oneida County (Section 22, T35N, R11E). No additional infected elms were noted in Eagle River (Vilas County) and Laona (Forest County) where a few trees were infected in 1969 and removed the same year. An aerial survey on August 8 in Florence County revealed a new area of severe elm mortality in a stand of northern hardwoods (Section 21, T39N, R17E).

Aerial and ground surveys for Dutch elm disease in Menominee County showed a continuing spread and intensification along the waterways and adjacent uplands (Figure 3). Infection was also noted in scattered sawlog trees throughout most of the mixed hardwood forest in the northwestern part of the county.


LANGLADE CO.
OCONTO CO.
SHAWANO CO.
MENOMINEE
STOCKBRIDGE INDIAN RESERVATION
Town of Polar
Town of Evergreen
Town of Wolf River
Town of Doty
Town of Armstrong
Town of Breed
Town of How
Town of Underhill
Town of Bartelme
Town of Richmond
Town of Wescott
Town of Norwood
Town of Hutchins
R-13-E
R-14-E
R-15-E
R-16-E
T-30-N
T-29-N
T-28-N
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Neopit
Keshena
KESHENA FALLS
THE DALLES
Five Is. Cr.
Wolf R.
Legend L.
Present Critical Areas
Present High Hazard Areas
LEGEND
MILES OF HIGHWAY as of Jan. 1, 1965
STATE 41
COUNTY 54
LOCAL ROADS 84
TOTAL FOR COUNTY 179
Land Area 361 Sq. Mi.
Population 2,606
Co. Seat Keshena
DISTRICTS
TOWNSHIP NUMBERING
MENOMINEE CO.
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STATE OFFICE BUILDING
Madison Wisconsin
SCALE MILES
Corrected for
JAN. 1970
Compiled from U.S.G.S. Quadrangles
Based on Aerial Photographs
Grid based on Wisconsin coordinate system, north zone
*Surface types on town roads not shown.
MENOMINEE 72-3

Figure 3. Dutch elm disease hazard, Menominee County - 1971

As a result of these surveys and discussions with representatives of the Department of Natural Resources, the U. S. Forest Service and Menominee Enterprises, Inc., the following revised elm cutting policy was adopted for Menominee County by the Natural Resources Board on November 19, 1971:

1. Elm 16" DBH and larger to be cut in recently logged areas in Sections 29, 30, 31 and 32 in T29N, R13E; also in Sections 28 and 33, those parts lying west of Red River also being in T29N, R13E.

2. Elm 16" DBH and larger to be cut in other recently logged areas of heavy Dutch elm disease infections in a manner jointly agreed upon between the DNR liaison forester and Menominee Enterprises, Inc., chief forester.

3. Only the elm sawlog volume developing from the area spelled out in paragraph (1), and from other critical areas agreed upon by DNR and MEI personnel would be considered additional to annual allowable cut. This logging season that volume could reach 2½ million feet.

4. In the area as spelled out in paragraph (1) which was recently logged, the residual basal area will range from a low of 20 sq. ft. to a high of 120 sq. ft., 11" DBH and up. Approximately 500 acres in this area will average approximately 20 - 40 sq. ft. with some 3 - 4 acre openings with no sawlog volume.

5. Marking prescriptions will aim at cutting all elm 16" DBH and larger. In dense concentrations of elm basal area may be reduced to no lower than 50 sq. ft. following logging. When necessary, higher priority elm may be left for stocking. Trees of other species will be favored as stocking residuals.

6. Occasionally group selection of up to 1/5 acre openings may be necessary in pockets comprised entirely of elm.

7. Every effort will be made to stay within the present Management Plan of scheduled compartment entry. Compartment entry, regardless of scheduling and when circumstances warrant, will be by written request and mutual agreement between Menominee Enterprises, Inc. and the Department of Natural Resources personnel.

8. In or near lowland types, and within a 5 chain perimeter or boundary, marking emphasis will be on all elm 16" DBH and larger.

At Devil's Lake State Park (Sauk County), Bidrin treatment was discontinued in 1971. Eight of 45 elms treated with Bidrin in 1970 became infected in 1971. These trees were part of a Bidrin field test initiated in 1967 when 95 elms were treated (Table 2).

Table 2. Survival of Bidrin Injected Elms, Devil's Lake State Park, 1967-71

	Number of Elms		
Year	Treated	Diseased*	Remaining
1967	95	9	86
1968	86	17	69
1969	69	17	52
1970	52	7	45
1971	0	8	37

$$\frac{\text{Remaining elms (1971)}}{\text{Original Elms (1967)}} = \frac{37}{95} = 39\% \text{ Survival}$$

In 1971 approximately 260 infected untreated elms were marked for removal. A similar number of untreated infected elms were removed in 1970.

Oak Wilt - Ceratocystis fagacearum (Bretz) Hunt

There was no change in the statewide distribution of oak wilt in Wisconsin during 1971 (Figure 4).

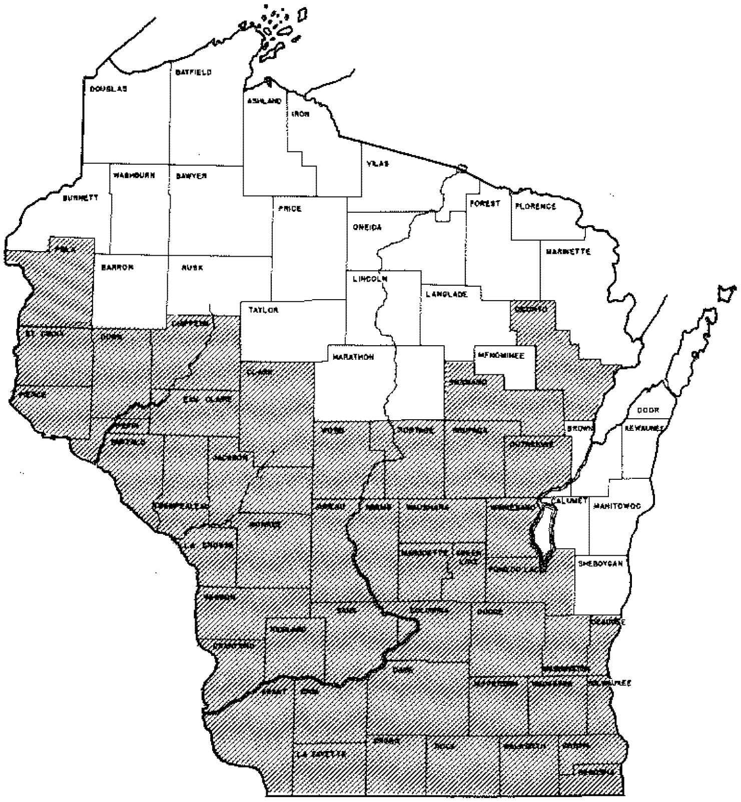

DOUGLAS
BAYFIELD
ASHLAND
IRON
VILAS
WASHBURN
SAWYER
BURNETT
PRICE
ONEIDA
FOREST
FLORENCE
MARINETTE
BARRON
RUSK
LINCOLN
LANGLADE
TAYLOR
MARATHON
MENOMINEE
EAU CLAIRE
JACKSON
LA CROSSE
DOOR
KEWAUNEE
BROWN
CALUMET
MANITOWOC
SHEBOYGAN
MILWAUKEE

Figure 4. Known distribution of oak wilt in Wisconsin - 1971.

Butternut Dieback - Melanconis juglandis (E. & E.) Graves

Widespread dying of butternut was first reported in southwestern Wisconsin in 1967. An examination of some of the areas at that time indicated the fungus Melanconium oblongum Berk., the imperfect stage of Melanconis juglandis was associated with the dieback (Figure 5). Several areas were sampled in Grant County and exploratory studies on the problem were initiated in 1969 at the University of Wisconsin-Madison.

Known areas of butternut dieback in Grant County were mapped in 1970 (Annual Report, Forest Pest Conditions in Wisconsin - 1970, page 30). In 1971, the Department of Natural Resources cooperated with the U. S. Department of Agriculture Forest Service, Forest Pest Control, State and Private Forestry, St. Paul, Minnesota in an aerial survey of two butternut dieback sites in Grant County (Figure 6). The sites were photographed on July 27 with Kodak Aero Ektachrome, Type 2448 and on July 31 with Kodak Aero Ektachrome Infrared, Type 2443, 9" x 9" format at a scale of 1:2400 (1" = 200').

Four plots each 4 acres in size were selected from the film and interpreted on a light table with a 10x hand lens. Dead and declining species were circled on the photos and identified as butternut or non-butternut. The plots were then field checked and compared with the aerial photographs. Preliminary results indicated that conventional color was better than infrared color for detecting dead and dying hardwoods. Also, it was difficult to differentiate dead butternut from oak wilt-killed red and black oak. A detailed report of this survey will be issued by U. S. D. A. Forest Service, Forest Pest Control, State and Private Forestry, St. Paul, Minnesota.

Butternut was examined in other areas in Wisconsin and the imperfect stage, Melanconium oblongum was collected (Table 3). Throughout the range of butternut there was some dieback but no tree mortality similar to that found in southwestern Wisconsin.

Table 3. Collections of Melanconium oblongum Berk. on butternut twigs

County	Location	Date
Buffalo	NWSW, Sec. 1 T21W, R13W	September 9, 1971
Sauk	NWSW, Sec. 1 T13N, R4E	October 28, 1971
Sawyer	SWSW, Sec. 10 T37N, R3W	September 8, 1971
Washburn	NENW, Sec. 21 T40N, R13W	November 12, 1971
Waushara	NESW, Sec. 6 T18N, R9E	October 21, 1971
Waushara	W½NW¼, Sec. 3 T19N, R8E	October 21, 1971

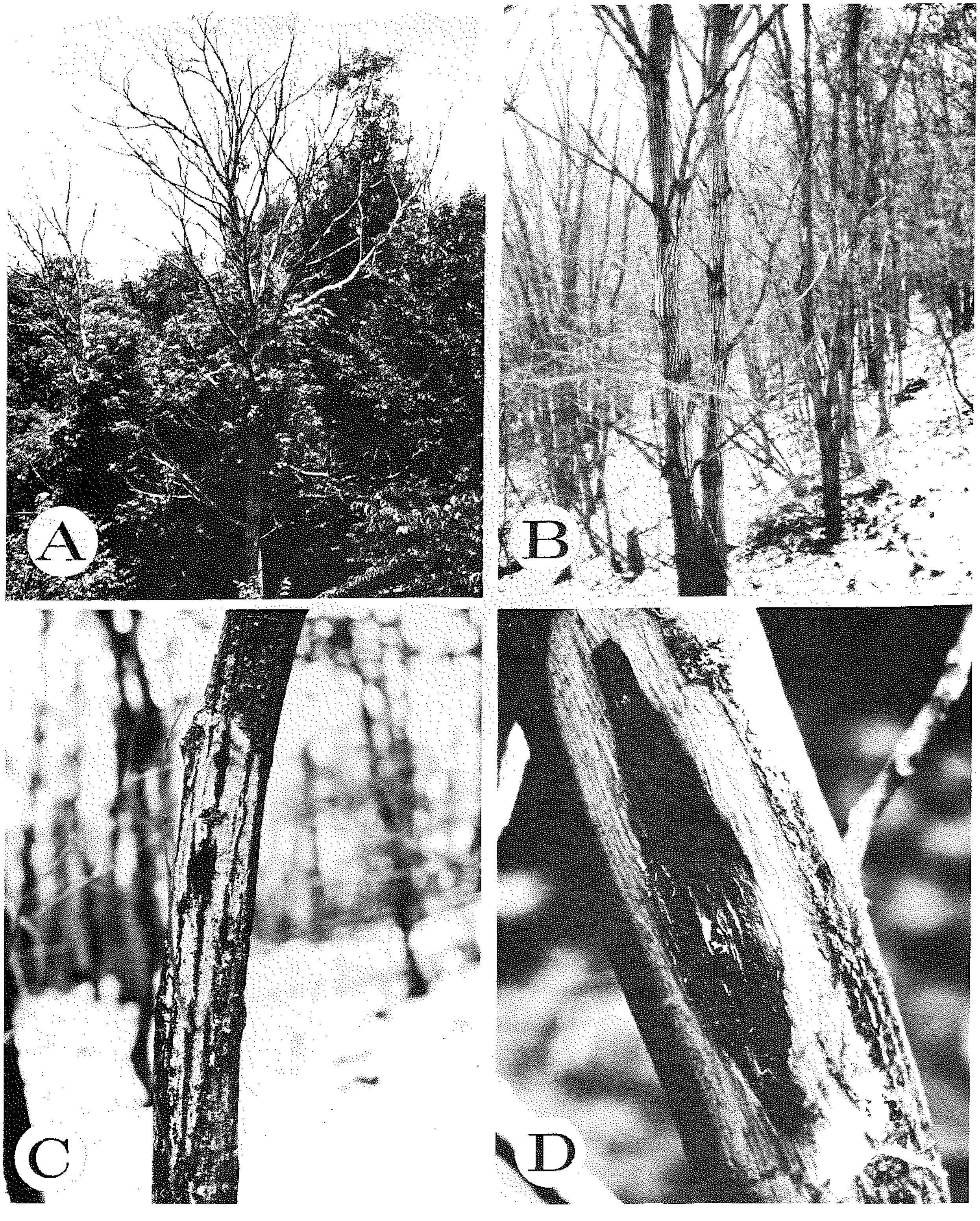


Figure 5. The fungus Melanconis juglandis is associated with butternut dieback in southwest Wisconsin. A. Dieback in Grant County. B. Cankered pole-size trees. C. Black conidia oozing from bark. D. Section of an acervulus.

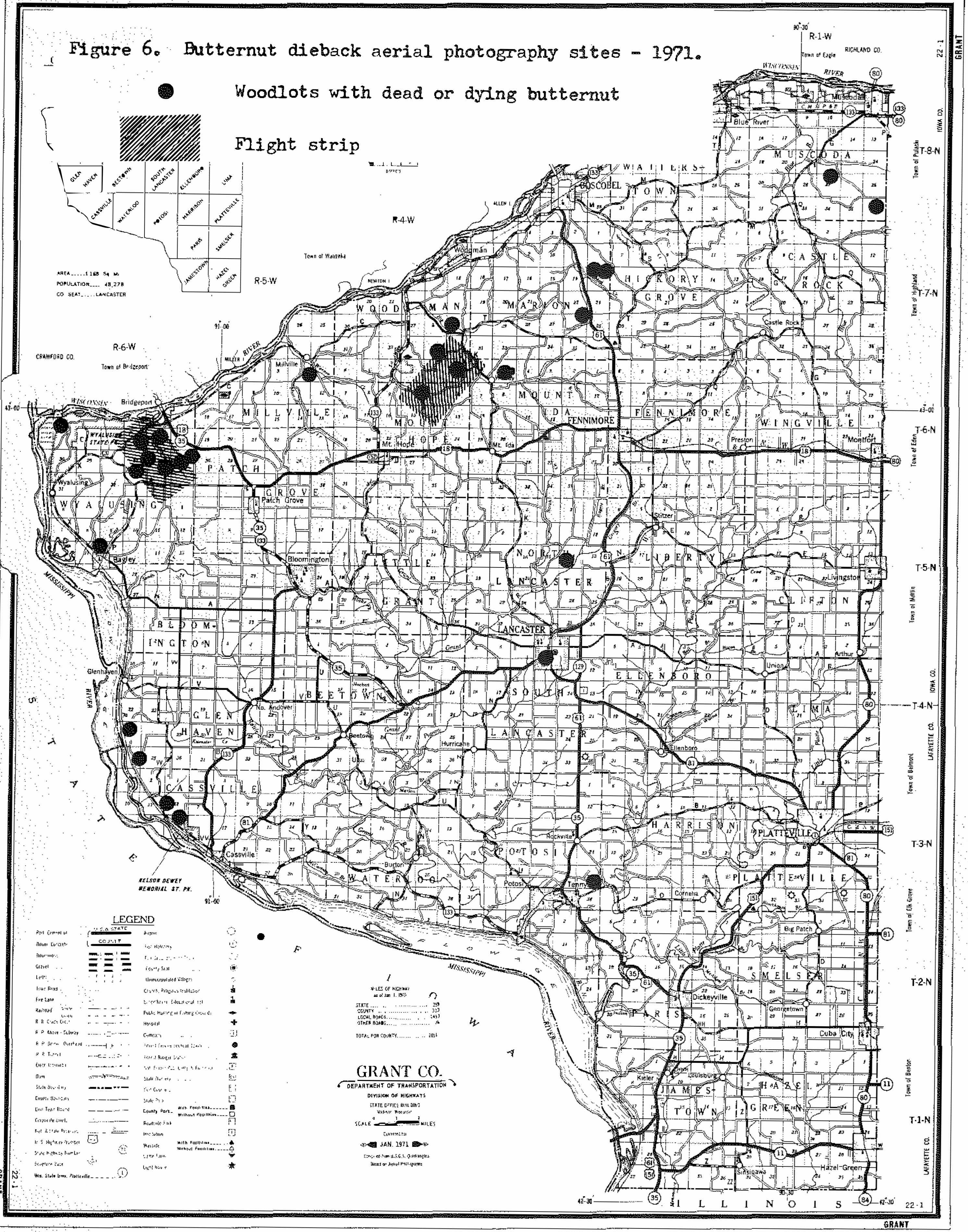


Figure 6. Butternut dieback aerial photography sites - 1971.

● Woodlots with dead or dying butternut
▨ Flight strip
GRANT CO.
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STATE OFFICE BUILDING
Madison, Wisconsin
SCALE MILES
JAN. 1971
LEGEND
AREA 1,168 SQ. MI.
POPULATION 48,278
CO. SEAT LANCASTER
MUSCODA
HICKORY GROVE
CASTLE ROCK
WOODMAN
MARION
MOUNT IDA
FENNIMORE
WINGVILLE
MILLVILLE
MOUNT HOPE
PATCH GROVE
WYALUSING
LITTLE GRANT
NORTH LANCASTER
LIBERTY
CLIFTON
BLOOMINGTON
LANCASTER
ELLENBORO
BEETOWN
SOUTH LANCASTER
GLEN HAVEN
CASSVILLE
HARRISON
PLATTEVILLE
POTOSI
WATERLOO
SMELSER
PARIS
JAMESTOWN
HAZEL GREEN
LIMA
WATTERSTOWN
MISSISSIPPI RIVER
WISCONSIN RIVER
ILLINOIS
IOWA CO.
LAFAYETTE CO.
RICHLAND CO.
CRAWFORD CO.
NELSON DEWEY MEMORIAL ST. PK.
WYALUSING STATE PK.
R-1-W
R-4-W
R-5-W
R-6-W
T-1-N
T-2-N
T-3-N
T-4-N
T-5-N
T-6-N
T-7-N
T-8-N

Black Walnut Dieback - Melanconis juglandis E. & E. Graves

Melanconium oblongum Berk., the imperfect stage of Melanconis juglandis was collected from a group of dying black walnut trees in Crawford County (SENW, Section 26, T10N, R4W). Approximately 30 trees 6 - 8 inches in diameter on five acres were affected.

Sapstreak of Sugar Maple - Ceratocystis coerulescens (Munch) Bakshi

Sapstreak of maple was isolated from 4 dying maple trees on the Nicolet National Forest (Argonne Experimental Forest, Section 33, T38N, R12E, Forest County) by Ken Kessler, Plant Pathologist, North Central Forest Experiment Station, St. Paul, Minnesota.

This disease has been reported in North Carolina, Upper Michigan, and Vermont but this is the first report of the disease in Wisconsin. The disease is distinguished by the presence of a thin crown bearing slightly clorotic leaves which are one-half the size of normal leaves and the tree dies within a year or two.

Sapstreak maybe mistaken for salt injury. However, in a cross section, the sapwood appears watersoaked with green, gray and red streaking radiating toward the bark.

Maple Decline - Physiological

Within cities and along highways, drought and highway de-icing salt has affected thousands of sugar maples. Symptoms include premature coloration and dieback. Forest trees have not been observed as being affected.

Large Tooth Aspen Decline - Unknown

Decline of large tooth aspen (Populus grandidentata), characterized by thin crowns and top decline was observed in scattered areas in Langlade County and on the Northern Highland State Forest in Vilas County. Individual clones of 50 - 60 year old large tooth aspen were affected, and crown dieback varied from 10% to 100%. Trembling aspen (Populus tremuloides) the same age was not affected.

ROOT ROTS

Shoestring Root Rot - Armillaria mellea (Vahl ex Fr.) Kummer

Mortality of red and white pine reproduction occurred on a 1,200 acre area in Menominee County (Sections 3, 9, 10 and 11, T28N, R16E). Approximately 5% of the red pine and less than 1% of the white pine were killed. The pines are established under a northern pin oak overstory which had heavy mortality associated with past infestations of walkingstick and two-lined chestnut borer (Figure 13E). Most of red pine mortality occurred around the dead oak clumps.

Several red pine plantations in Bayfield, Douglas and Washburn counties were infected with Armillaria mellea following herbicide treatment of the oak overstory 3 - 5 years ago. Pine mortality ranged from a few scattered trees to about 20 percent.

An A. mellea study plot was established on the Brule River State Forest (Section 12, T46N, R10N, Douglas County) by forest pathologists at the University of Wisconsin. The oak overstory was hand released and planted with red pine in 1963 and 1964. The area was then herbicided in 1967 and red pine mortality noted in 1970 (Figure 7). In a similar study area in Marinette County (NW¼SW¼, Section 31, T33N, R19E) there was 24% mortality of red pine from A. mellea associated with the oak overstory that was aerially herbicided in 1966 with 2,4,5-T (0.5 lb.) + 2,4-D (1.5 lb.) per 4 gal. H_2O/acre.

Scattered patches of dead and dying red pine were also noted around old oak stumps in a plantation in Marathon County (Section 14, T27N, R8E). Mycelial fans were present on all trees examined.

Armillaria mellea was reported killing approximately 10% of the trees in a 20-acre red pine plantation that was hand planted on the Northern Highland State Forest in Vilas County in 1964 (SW¼NE¼, Section 4, T41N, R7E). The oak and maple overstory was girdled from 1960 - 65 and then cut in 1968. Mortality has occurred over the past two or three years and is continuing.

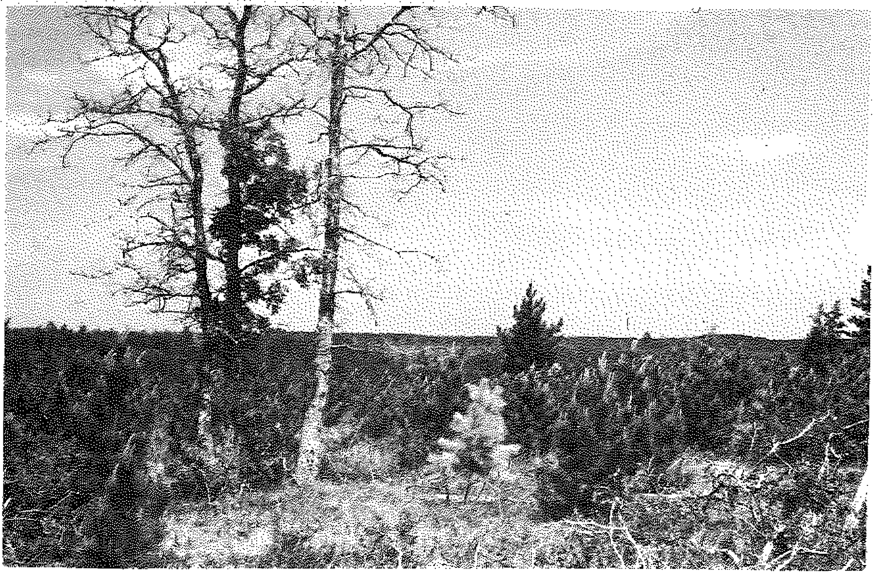


Figure 7. Red pine killed by Armillaria mellea is adjacent to a herbicide killed oak. Brule River State Forest.

FOLIAGE DISEASES

Brown Spot Needle Blight - Lecanosticta acicola (Thuem.) Syd.

Brown spot continued to damage Scotch pine Christmas trees in Wisconsin. Christmas tree growers applied Bordeaux mixture, 8-8-100 on approximately 1,000 acres of plantations and successfully controlled the disease. The disease is now present in 18 counties on approximately 3,000 acres. Brown spot was found for the first time in Pepin and Wood counties in 1971 (Figure 8).

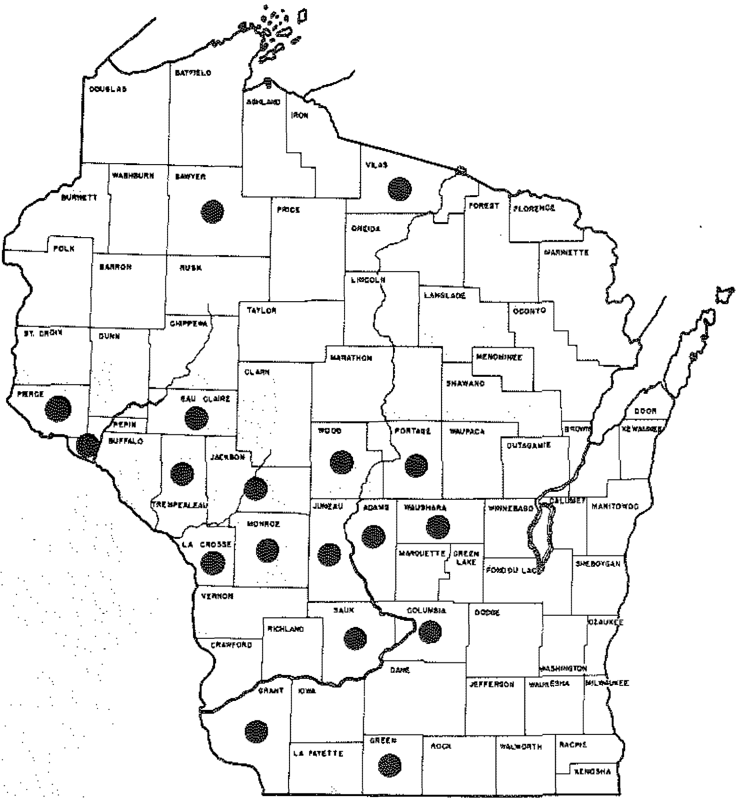

DOUGLAS
BAYFIELD
ASHLAND
IRON
VILAS
WASHBURN
SAWYER
BURNETT
PRICE
ONEIDA
FOREST
FLORENCE
POLK
BARRON
RUSK
MARINETTE
LINCOLN
LANGLADE
OCONTO
TAYLOR
ST. CROIX
DUNN
CHIPPEWA
MARATHON
MENOMINEE
CLARK
SHAWANO
PIERCE
EAU CLAIRE
PEPIN
BUFFALO
WOOD
PORTAGE
WAUPACA
OUTAGAMIE
BROWN
DOOR
KEWAUNEE
JACKSON
TREMPEALEAU
JUNEAU
ADAMS
WAUSHARA
WINNEBAGO
CALUMET
MANITOWOC
MONROE
LA CROSSE
MARQUETTE
GREEN LAKE
FOND DU LAC
SHEBOYGAN
VERNON
SAUK
COLUMBIA
DODGE
OZAUKEE
RICHLAND
CRAWFORD
WASHINGTON
DANE
JEFFERSON
WAUKESHA
MILWAUKEE
GRANT
IOWA
LA FAYETTE
GREEN
ROCK
WALWORTH
RACINE
KENOSHA

Figure 8. Known county distribution of brown spot disease of Scotch pine in Wisconsin - 1971.

Brown spot was observed and isolated from red pine at two different locations in Wisconsin in 1970 by Thomas H. Nicholls and George Hudler of the North Central Forest Experiment Station, U. S. Department of Agriculture Forest Service, St. Paul, Minnesota. Red pine is a new host record for brown spot and was discovered while the North Central Forest Experiment Station was conducting research studies on the fungus in Wisconsin. The disease was first observed on July 21, 1970 on a 25-year-old red pine windbreak growing among heavily infected Scotch pine of the same age near Brodhead, Wisconsin (Section 1, T1N, R9E, Green County). The other collection was made on October 1, 1970 from 8-year-old red pines planted within a Scotch pine Christmas tree plantation near Boscobel, Wisconsin (Sections 18 and 19, T8N, R2W, Grant County). In both areas the infection was confined to the previous year's needles and was light. Studies are in progress at the North Central Forest Experiment Station to learn of the importance of the disease on red pine.

Previously unreported locations of brown spot in Wisconsin are listed in table 4.

Table 4. New Locations of Brown Spot Needle Blight on Scotch Pine in Wisconsin, 1971

County	Location	Remarks
Adams	W½SE¼, Sec. 9 T17N, R7E	20 acres
Adams	NWSE, Sec. 10 T19N, R6E	1 acre
Columbia	E½NE¼, Sec. 4 T13N, R8E	3 acres
Columbia	NE¼, Sec. 5 T13N, R8E	1 or 2 trees
Jackson	NWSW, Sec. 2 T21N, R5W	10 acres
Jackson	NENE, Sec. 3 T21N, R5W	3 acres
Pepin	Sec. 32, T23N, R15W	2 - 3 acres
Wood	NENE, Sec. 29 T21N, R5E	

Most of the major Wisconsin Christmas tree growers with serious brown spot needle blight problems attempted chemical control in 1971. Many of the areas sprayed were the same as in 1970; however, there were some additions and deletions.

There was no aerial spraying in Wisconsin to control needle blight, and Bordeaux mixture was the only fungicide applied commercially.

A variety of ground equipment was used for needle blight control. The only new innovation was the use of a "Low Volume" Kinkelder mist blower by Northern Christmas Tree Growers of Merrillan. This machine used a concentrate Bordeaux spray of 50-50-100 applied at a rate of 20 gallons per acre (approximately 10 lbs. $CuSO_4$ and 10 lbs. lime per acre). This machine was supplemented by a Bean "High Volume" mist blower applying 8-8-100 Bordeaux spray at 70 to 100 gallons per acre. This company also used a Highboy Hydraulic sprayer with hand guns to treat blocks with insufficient roads for mistblower coverage (Table 5).

Table 5. Brown Spot Needle Blight Spraying, 1971 - Northern Christmas Trees

		Treatment Number			
County	Location	1 (acres)	2	Dates	Equipment*
Jackson	T19N R5W Sec. 28	15		6/21	MB-LV
"			29	7/26	HB
"	T19N R5W Sec. 31	6		7/22	MB-HV
"	T19N R5W Sec. 32	5		6/21	MB-LV
"	T19N R5W Sec. 32		8	7/25	MB-HV
"	T20N R3W Sec. 4	15		7/2	MB-HV
"	T20N R3W Sec. 7	42		7/1 & 2	MB-LV
"	T20N R3W Sec. 7		8	7/14	HB
"	T20N R3W Sec. 9	24		7/2	MB-LV
"	T20N R4W Sec. 1	4		7/2	MB-LV
"	T20 R4W Sec. 3	25		6/30 & 7/1	MB-LV
"	T23 R5W Sec. 2	30		6/15 & 18	MB-LV
"	T23 R5W Sec. 20 & 21	20		6/15	MB-LV
"	T23 R5W Sec. 20 & 21		8	7/9	HB
"	T24 R5W Sec. 25	24		7/3, 5, 6	HB
"	T24 R5W Sec. 29	40		7/9	MB-LV
"	T24 R5W Sec. 30	24		7/22	MB-HV
"	T24 R5W Sec. 32	22		7/6, 7, 9	HB
"	T24 R6W Sec. 11	5		7/6	MB-LV
"	T24 R6 Sec. 15	20		7/24	MB-LV
"	T24 R6W Sec. 22	5		7/6	MB-LV
"	T24 R6 Sec. 24	20		7/22 & 23	MB-LV
"	T24 R6W Sec. 30	40		7/6, 7, 9	MB-LV
Juneau	T15N R4E Sec. 24	20		6/24	MB-LV
"	T16N R4E Sec. 29	20		6/29	MB-LV
"	T16N R4E Sec. 29		15	8/20	MB-HV
"	T16N R5E Sec. 29	70		6/23 - 26	MB-LV
"	T16N R5E Sec. 29		46	8/15 - 20	MB-HV
"	T17N R3E Sec. 24	8		6/29	MB-LV
"	T18N R4E Sec. 33	20		6/29	MB-LV
"	T18N R4E Sec. 33		10	8/27	MB-HV
La Crosse	T18N R5W Sec. 6	5		6/21	MB-LV
"	T18N R5W Sec. 6		12	7/22	MB-LV

*MB-LV	Kinkelder Mistblower - Low Volume
MB-HV	Bean Mistblower - High Volume
HB	Highboy Hydraulic

Howard Pierce, Black River Falls used a Bean "High Volume" mistblower to apply 8-8-100 Bordeaux mixture at 40 to 60 gallons per acre (Table 6). Rollin Darst, a custom applicator, treated some small acreages using a smaller hydraulic sprayer, mounted on a truck, with hand guns on hose lines (Table 7).

The G. R. Kirk Company, Wautoma treated 604 acres of Scotch pine Christmas trees with 8-8-100 Bordeaux mixture using a Bean Roto-Mist blower averaging 43 gallons of water per acre (Table 8).

Additional mistblower applications of Bordeaux mixture were applied by other growers in Green and Jackson counties (Table 9).

Table 6. Brown Spot Needle Blight Spraying, 1971 - Howard Pierce

County	Location	Acres	Date	Equipment*
Jackson	T20N R1W Sec. 27	10	7/6	MB-HV
"	T20N R3W Sec. 9	15	7/7	MB-HV
Monroe	T19N R3W Sec. 28	62	6/29 - 7/2	MB-HV
"	T19 R4 Sec. 17	11	7/5	MB-HV
"	T19 R4 Sec. 26	20	7/8	MB-HV

*MB-HV Bean Mistblower - High Volume

Table 7. Brown Spot Needle Blight Spraying, 1971 - Rollin Darst

County	Location	Treatment Number 1 (acres)	Treatment Number 2 (acres)	Date	Equipment
Jackson	T21N R5W Sec. 2	5		7/9	Hydraulic
"	T21N R5W Sec. 5	5		7/13	Hydraulic
"	T22N R5W Sec. 27	1		7/14	Hydraulic
"	T22N R5W Sec. 32	20		7/14	Hydraulic
Trempealeau	T24N R7W Sec. 7	8		June	Hydraulic
"	T24N R7W Sec. 7		8	7/10	Hydraulic

Table 8. Brown Spot Needle Blight Spraying, 1971 - G. R. Kirk Company

County	Location	Acres	Date	Fungicide	Equipment
Portage	T20N R7E Sec. 31, 32	160	7/8 - 13	Bordeaux	Mistblower
"	T21N R10E Sec. 32	86	7/6, 7	"	"
"	T21N R10E Sec. 33	75	7/1, 2	"	"
Waushara	T19N R8E Sec. 23, 26	100	7/16 - 19	"	"
"	T19N R9E Sec. 6	40	7/15		
"	T20N R10E Sec. 8	75	7/14 - 15	"	"
"	T20N R10E Sec. 29	38	7/14 - 15	"	"
"	T20N R10E Sec. 3	30	7/8	"	"

Table 9. Other Brown Spot Needle Blight Spraying, 1971

County	Location	Acres	Date	Equipment
Green	T1N R9E Sec. 5	12	July	Mistblower
Jackson	T21N R5W Sec. 16	3	June	Mistblower

Lophodermium Needle Cast - Lophodermium pinastri (Schrad.) Chev.

Lophodermium needle cast, a problem on Scotch pine Christmas trees in 11 northeastern states, has not been a problem in Wisconsin. The disease has been observed in only one Scotch pine plantation which is in Richland County (Section 21, 22, T9N, R2E). Lophodermium has been a problem in the past on red pine seedlings at the Hugo Sauer Nursery at Rhinelander but treating the seedbeds with the fungicide Maneb has controlled the disease. Lophodermium was observed for the first time in seedbeds at Hayward Nursery. A small area of 3-0 red pine was affected. The infected trees were destroyed and the remaining red pine sprayed with Maneb.

Spruce Needle Cast - Rhizosphaera kalkhoffii Bub.

Rhizosphaera kalkhoffii continued to damage Colorado blue spruce Christmas tree plantations in 1971. The disease has been present in Wisconsin on ornamental blue spruce for several years but was only recently recognized as a problem in Christmas tree plantations (Figures 9 and 10). In 1970 more than 20,000 blue spruce Christmas trees were sprayed with copper based fungicides (DNR, Annual Report, Forest Pest Conditions in Wisconsin, 1970). Spraying appeared to prevent infection of the current year's needles that year so the same Christmas tree growers continued to spray their trees in 1971 with Bordeaux mixture (Table 10).

Table 10. Christmas Tree Plantations Treated for Control of Rhizosphaera kalkhoffii on Colorado Blue Spruce, Wisconsin 1971

County	Location	Treatment Number 1 (acres)	Treatment Number 2 (acres)	Dates	Fungicide	Equipment*
Clark	Sec. 8 T24N R4W	15		6/28	Bordeaux	MB-HV
"	Sec. 8 T24N R4W		15	7/25	"	MB-HV
Jackson	Sec. 7 T20N R3W	4		7/1 - 2	"	MB-LV
"	Sec. 7 T20N R3W		4	7/14	"	HB

*MB-HV	Mistblower - High Volume
MB-LV	Mistblower - Low Volume
HB	Highboy

Because of the R. kalkhoffii problem on Christmas trees in 1970 and 1971, previous collections of R. kalkhoffii were re-examined and tabulated along with current year's collections (Table 11). A collection of R. kalkhoffii on black spruce (Picea mariana) in Vilas County on June 13, 1967 by Robert F. Patton and Allen J. Prey is the first record of the fungus on this host in Wisconsin.

Also present was an October 10, 1961 collection of R. kalkhoffii from a five to 10 foot tall white spruce plantation near Gauld City, Michigan. (See Annual Report, Forest Pest Conditions in Wisconsin - 1961).

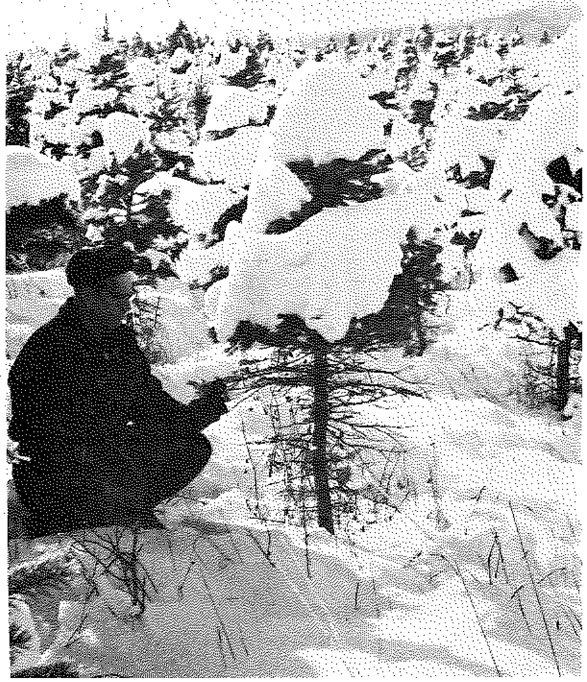


Figure 9. Damage by Rhizosphaera kalkhoffii is confined to the lower portion of infected Colorado blue spruce (Sec. 8, T44N, R4W, Clark County).

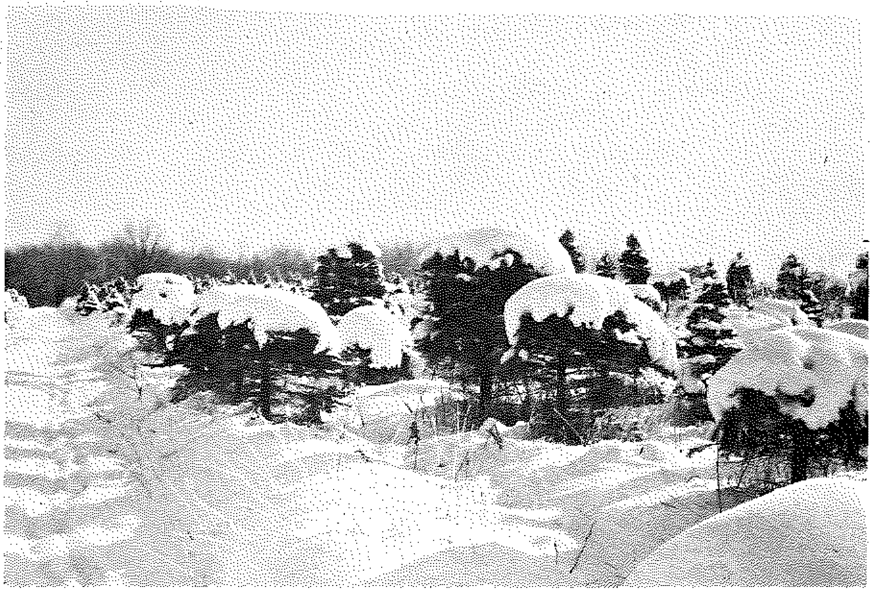


Figure 10. Christmas tree growers in Clark County salvaged blue spruce infected with Rhizosphaera kalkhoffii.

Table 11. Collections and Records of *Rhizosphaera kalkhoffii* in Wisconsin

County	Location	Date	Host
Adams	Friendship, Wis.	12/19/69	Ornamental blue spruce
Barron	Windbreak in Cumberland, Wis.	6/2/66	White spruce
Clark	Sec. 8, T24N R4W	7/16/70	Blue spruce
Columbia	SESE, Sec. 19, T13N, R7W	8/9/67	Planted black spruce
Dane	Nevin Fish Hatchery	3/1/71	Ornamental blue spruce
Dane	U. of Wisconsin Arboretum	1961	White spruce
Green	Sec. 1, T1N, R9E	9/29/70	Blue spruce
Jackson	Sec. 7, T20N, R3W	6/22/70	Blue spruce
Langlade	SESW, Sec. 5 T31N, R12E	6/2/71	Blue spruce Christmas trees
Rock	Sec. 21, T1N, R10E	12/2/71	Blue spruce Christmas trees
Sauk	SWSE, Sec. 10 T8N, R3E	9/23/69	Blue spruce Christmas trees
Vilas	Sec. 13, T42N, R11E	8/22/68	Blue spruce
Vilas	SWSW, Sec. 16, T41N, R8E	6/13/67	Black spruce
Waukesha	NWNW, Sec. 18. T6N, R18E	3/12/70	Ornamental blue spruce
Waushara	Sec. 28, T20N, R12E		Blue spruce

White Pine Needle Blight - Atmospheric Gases

White pine needles are sensitive indicators of the presence of relatively low concentrations of sulfur dioxide and ozone in the atmosphere. Either of these gases causes a characteristic reddish-brown discoloration of the needle tips which is known as tip-burn or white pine needle blight.

Tip-burn of needles of white pine was not nearly as severe or widespread as it was in 1970, when 50% or more of the trees in some localities in the Northern Highland State Forest and other areas showed the reddish-brown discoloration. Approximately 100 white pines were examined in E½ E½ Section 24, T42N, R5E on the Northern Highland State Forest (Vilas County) in 1971, and only 4 trees had white pine needle blight. Saw-log white pine trees at the Little Bohemia Resort, also in Vilas County (NWSE Section 15, T42N, R5E), had severe tip-burn of needles in 1970, but none in 1971. The 1970 needles were still retained on the identical trees which were examined in early November each of the two years.

White pine needle blight continued to occur on approximately 10% of the white pine Christmas trees in Green and Rock counties in 1971 (Figure 11). Needle blight symptom development was recorded in conjunction with air pollution indicator studies at a Christmas tree plantation in Green County (Appendix A, page 48).

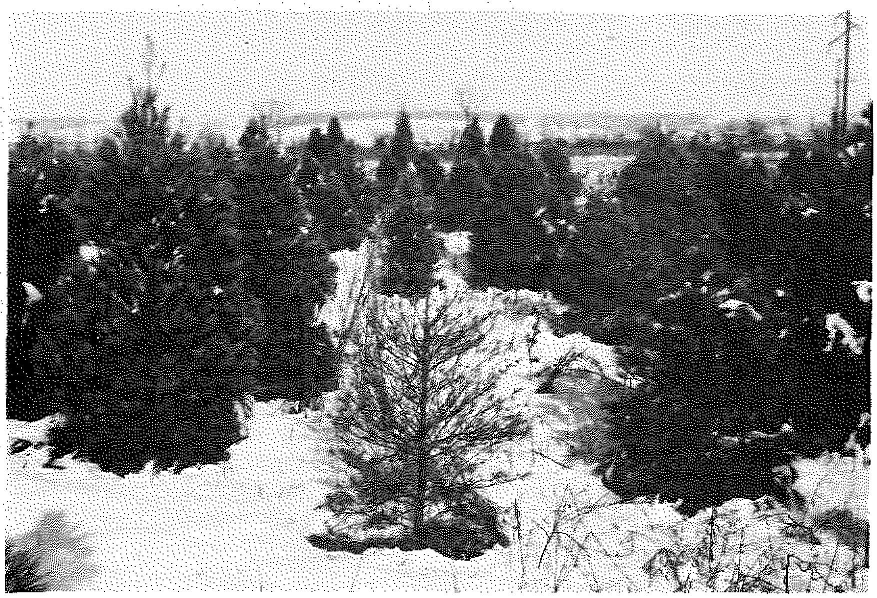


Figure 11. White pine Christmas tree with needle blight near Avon, Wisconsin (Rock County) - December, 1971

Air Pollution

The Department of Natural Resources Air Pollution Control Section requested that several areas be examined in 1971 for possible damage to vegetation from air pollutants.

Alma, Wisconsin

Vegetation at Buena Vista Park (NWSW, Section 1, T21N, R13W) which is located on a bluff near Alma, Wisconsin was examined for possible air pollution injury from the nearby coal-burning power plant. Sulfur dioxide injury was observed on white birch, sumac and basswood. No injury was observed on an alfalfa field south of the park (Section 35, T21N, R13W). Sulfur dioxide injury was not observed on vegetation growing at the base of the bluff within the city limits.

Sheboygan, Wisconsin

A survey was made in the City of Sheboygan and in the Black Creek Subdivision (south of town) on August 19 for possible sulfur dioxide injury to vegetation. No air pollution injury was observed in the area. Decidious and coniferous trees at Shooting Park, Ruth Balzer Memorial Park Forest and Sheboygan Indian Mound Park were free of air pollution injury on current year's foliage. Cabbage, squash and tomato plants at a truck farm approximately ½ mile southwest of the Edgewater Generating Station were free of air pollution injury.

White pine needle blight was observed on 1971 needles of three white pines at Michael Kohler State Park. It was not known if the needle blight was caused by sulfur dioxide or naturally occurring ozone. No white pine needle blight was observed at Terry Andrae State Park.

Sheboygan Falls, Wisconsin

A follow-up of a 1970 air pollution investigation at an aluminum refining plant near Sheboygan Falls on August 19, 1971 did not reveal air pollution injury to vegetation in the area.

STEM AND BRANCH DISEASES

Fir Broom Rust - *Melampsorella caryophyllacearum* Schroet.

Witches brooms that appear to be caused by the rust fungus *Melampsorella caryophyllacearum* were observed on balsam fir in northern Bayfield County (Section 34, T52N, R4W). The alternate hosts for this rust are chickweed (*Stellaria* spp.) and mouse-ear chickweed (*Cerastium* spp.). The rust has been collected on *Stellaria media* in Wisconsin.

Balsam Fir Canker - *Aleurodiscus amorphus* (Pers.) Rabenh.

The fungus *Aleurodiscus amorphus* was found in association with stem cankers on suppressed sapling and pole-size balsam fir in Forest, Langlade and Oneida counties. The cankers are narrow and eliptical with a raised border and sunken center. A branch stub is usually present in the center and fruiting bodies of A. amorphus can be found in the center and margin of the canker.

A 3-acre area of balsam fir in Oneida County (Section 29, T36N, R9E) was moderately cankered. Approximately 20% of the saplings were recently killed or were dying. Aleurodiscus cankers were present on most of these trees.

In Europe A. amorphus cankers have been reported to be associated with Chermes infestations on European silver fir (Abies pectinata). In North America, A. amorphus has been reported on Abies, Larix, Picea, Pinus, Pseudotsuga, Thuja and Tsuga. Alerodiscus amorphus has been severe on lowland white fir (A bi segrandis Lindl.) in Oregon and has been occasionally reported as a canker disease of suppressed balsam fir (Abies balsamea) in the northeastern United States.

Scleroderris Canker - Scleroderris lagerbergii Gremmen

Scleroderris lagerbergii was isolated from several trees within an 80-acre red pine die-up (Deerskin Droop) area in Vilas County (NW¼, Section 24, T42N, R9E).

The lower two whorls of branches were flagged on about 90% of the trees in the plantation. Infection appeared to have occurred in 1970. Permanent plots were established in the plantation to record disease progression on individual red pines.

Scleroderris symptoms were also observed in nearly 250 acres of a Vilas County Forest red pine plantation (Sections 31 and 32, T42N, R10E). However, infection was not as severe as the previous plantation.

Scleroderris also continued to damage red pine plantings in Northern Bayfield County where infections were found previously and reported in the 1967 Annual Report of Forest Pest Conditions in Wisconsin. Flagging was more prevalent on the lower two to five whorls of larger red pines in Bayfield County Forest Plantation #113 (Section 35, T50N, R6W), that was planted in 1958. There was no deerskin droop on native red pines or planted red pines in this area. There was also increased flagging and mortality from Scleroderris in an adjacent Nekoosa Edwards Paper Company red pine plantation in Section 36, T50N, R6W that was planted in 1965.

Diplodia Twig Blight

Diplodia pinea (Desm.) Kickx (Syn: Sphaeropsis ellisii Sacc.)

Diplodia pinea was found colonizing hail wounds of red pine in a Burnett County Forest plantation (Section 20, T41N, R15W). The area was furrowed and hand planted in the spring of 1958 with 3-0 stock from the Hayward Nursery. The ground cover at that time was sweet fern and grass. Release work was done in November, 1966. All scrub oak, aspen and wolf jack pine were cut or girdled. A severe hailstorm went through the area on May 6, 1965. When the area was examined in 1971, affected trees were in various stages of decline ranging from an occasional flagging branch or stem canker to complete mortality.

Several red plantations in Sections 9 and 16, T41N, R15W had the same symptoms as the plantation in Section 20. Mortality was scattered and not nearly as severe. The planting, about the same age as those in Section 20, had evidence of hail damage but specimens were not collected from these plantations.

Diplodia pinea was also collected and identified on blighted current year's shoots of an ornamental Austrian pine on November 11, 1970. The pine about 25-years-old was located in Berkmose Park north of Hudson, Wisconsin (St. Croix County). Symptoms were typical of those described for D. pinea, the current year's shoots were stunted, and brown with abundant pycnidia produced on the blighted needles. Similar symptoms were observed on an ornamental Austrian pine about the same age that was planted in front of a house in Hudson south of I-94.

OTHER

Red Pine Die-up and Tip Blight - Unknown

This unusual phenomenon, which has also been called Deerskin Droop of Red Pine, was observed in two new areas in Vilas County. The lower branches of affected trees die prematurely and current year's shoots are sometimes killed. It appeared as though the symptoms were initiated by insects feeding on the current year's shoots in July. However, a close examination of the shoots did not reveal any feeding scars.

The problem was most conspicuous on large mature native red pine within two 15-year-old red pine plantations in Vilas County (Table 12). Many of the planted trees surrounding the native pines had symptoms of deerskin droop. In both plantations, the lower two whorls of branches of the planted red pines were flagged and Scleroderris lagerbergii was isolated from several of the trees in the 80-acre private plantation in the NW¼, Section 24, T42N, R9E. However, Scleroderris was not found on drooping current year's shoots indicating that two different problems were present.

Table 12. New Locations of Red Pine Die-up and Tip Blight

County	Location	Acreage	Ownership
Vilas	NW¼, Sec. 24 T42N, R9E	80	Private
Vilas	Sec. 31 & 32 T42N, R10E	250	Vilas County Forest

Winter Injury

Thousands of Spanish variety Scotch pine Christmas trees in central Wisconsin turned brown in April and May. They did not die but their quality was reduced.

HEMLOCK MORTALITY

Aerial and ground surveys the past two years indicated that hemlock mortality is increasing on the forest lands in Menominee County (Figure 12). Post-logging salvage cuts of hemlock have caused problems for management in prior years. The earlier problems are now compounded by the need to salvage valuable associated elm which has been killed by Dutch elm disease. Mortality and removal of the two species presents an additional problem of maintaining adequate basal area on many sites.

Severe hemlock mortality, in what is now Menominee County, followed an extended drought period in the late 1930's. This was documented by Secrest, MacAloney and Lorenz[1].

Drought is also suspected as an important factor in the current mortality increase. Weather records from the Antigo Ranger Station (Langlade County) show that a precipitation deficiency occurred in late summer during each of the years 1968 through 1970. Each of these years had in common a dry period, bracketed by the dates July 25 through September 5, and which in some years extended beyond these dates. August, 1970 was the driest August recorded at Antigo in forty years.

Decadent hemlock characterized by sparse yellowing foliage, can usually be identified by the forestry marking crews. To further help them in selecting these trees, forest management personnel conducted a survey to record readily recognized symptoms that occur most consistently on dead and dying hemlock. A total of 450 pairs of healthy and declining trees were examined throughout the major portion of the hemlock type. Trees were paired on the basis of their proximity to one and another, and for their similarity in height, diameter and other physical characteristics. Unhealthy sample trees had to be alive but exhibit thinness of crown or chlorotic foliage. Comparisons of pairs of samples were made during the month of August. The extensive survey failed to produce any additional symptoms that appeared consistently enough to reliably permit their use in selecting high-risk trees.

Following are comments on the factors evaluated for each pair of hemlock trees:

Distribution of mortality - Mostly near roads or in recently logged areas.

Two compartments (Sections 13 and 14, T29N, R13E; and Sections 23, 24 and 26, T29N, R13E) had mortality extensive enough to salvage.

Armillaria mellea - Mycelial mats were present on the roots or root collars of nearly all dead and dying trees. Occurrence on healthy trees was impractical to determine without excavating the root systems.

---

[1] Secrest, H. C., H. J. MacAloney and R. C. Lorenz. Causes of decadence of hemlock at the Menominee Indian Reservation, Wisconsin. Jour. Forestry, 39: 3 - 12. 1941.

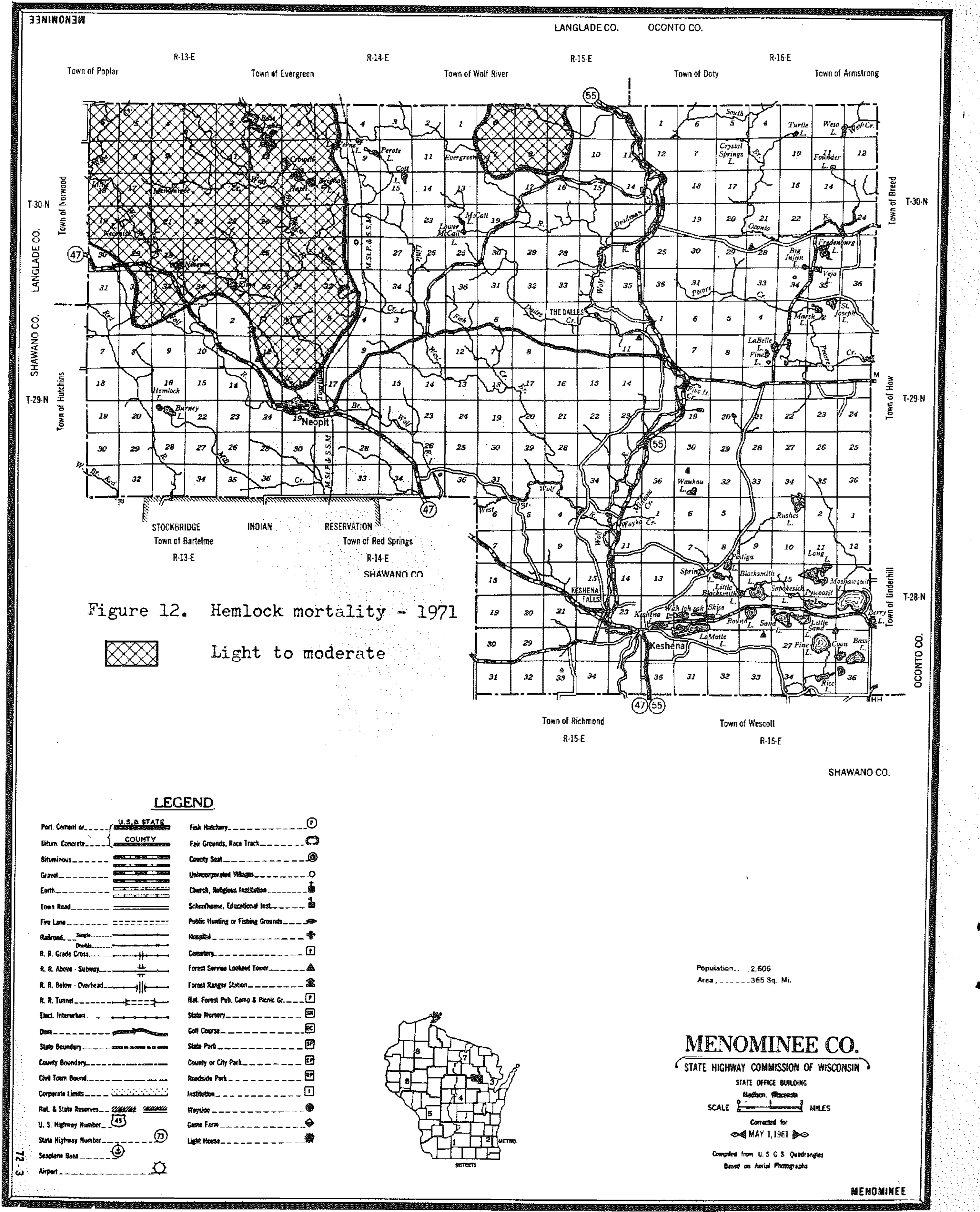

MENOMINEE
LANGLADE CO.
OCONTO CO.
R-13-E
R-14-E
R-15-E
R-16-E
Town of Poplar
Town of Evergreen
Town of Wolf River
Town of Doty
Town of Armstrong
Town of Norwood
Town of Hutchins
Town of Breed
Town of How
Town of Underhill
T-30-N
T-29-N
T-28-N
LANGLADE CO.
SHAWANO CO.
OCONTO CO.
Neopit
Keshena
THE DALLES
KESHENA FALLS
Hemlock L.
STOCKBRIDGE INDIAN RESERVATION
Town of Bartelme
Town of Red Springs
SHAWANO CO.
Town of Richmond
Town of Wescott
LEGEND
Port. Cement or Bitum. Concrete
U.S. & STATE
COUNTY
Bituminous
Gravel
Earth
Town Road
Fire Lane
Railroad Single Double
R. R. Grade Cross.
R. R. Above - Subway
R. R. Below - Overhead
R. R. Tunnel
Elect. Interurban
Dam
State Boundary
County Boundary
Civil Town Bound.
Corporate Limits
Nat. & State Reserves
U. S. Highway Number
State Highway Number
Seaplane Base
Airport
Fish Hatchery
Fair Grounds, Race Track
County Seat
Unincorporated Villages
Church, Religious Institution
Schoolhouse, Educational Inst.
Public Hunting or Fishing Grounds
Hospital
Cemetery
Forest Service Lookout Tower
Forest Ranger Station
Nat. Forest Pub. Camp & Picnic Gr.
State Nursery
Golf Course
State Park
County or City Park
Roadside Park
Institution
Wayside
Game Farm
Light House
DISTRICTS
METRO.
Population 2,606
Area 365 Sq. Mi.
MENOMINEE CO.
STATE HIGHWAY COMMISSION OF WISCONSIN
STATE OFFICE BUILDING
Madison, Wisconsin
SCALE MILES
Corrected for
MAY 1, 1961
Compiled from U. S. G. S. Quadrangles
Based on Aerial Photographs
72-3
MENOMINEE

Figure 12. Hemlock mortality - 1971

▨ Light to moderate

Water soaked butts - Wet bark just above the root collar was nearly always associated with armillaria on dying trees. However, approximately 15% of the apparently healthy trees also exhibited this symptom.

Logging damage - Incidence of skidding and felling damage, and evidence of effects of compaction were approximately 100% greater on dead and dying timber.

Sapsucker damage - No significant difference in paired samples.

Zig - zag ridging - This defect, which usually results in a cull butt log, apparently is due to frost injury. Approximately 60% of the samples had this defect, but there was no significant difference between the paired samples.

Hemlock borer - *Melanophila fulvoguttata* (Harris) - Larvae were usually present in dead and dying trees, but no evidence of successful borer attack was found in healthy trees.

Conclusions from the survey were that extended periods of drought the last few years and exposure of trees following logging were principal factors responsible for mortality of the hemlock in Menominee County.

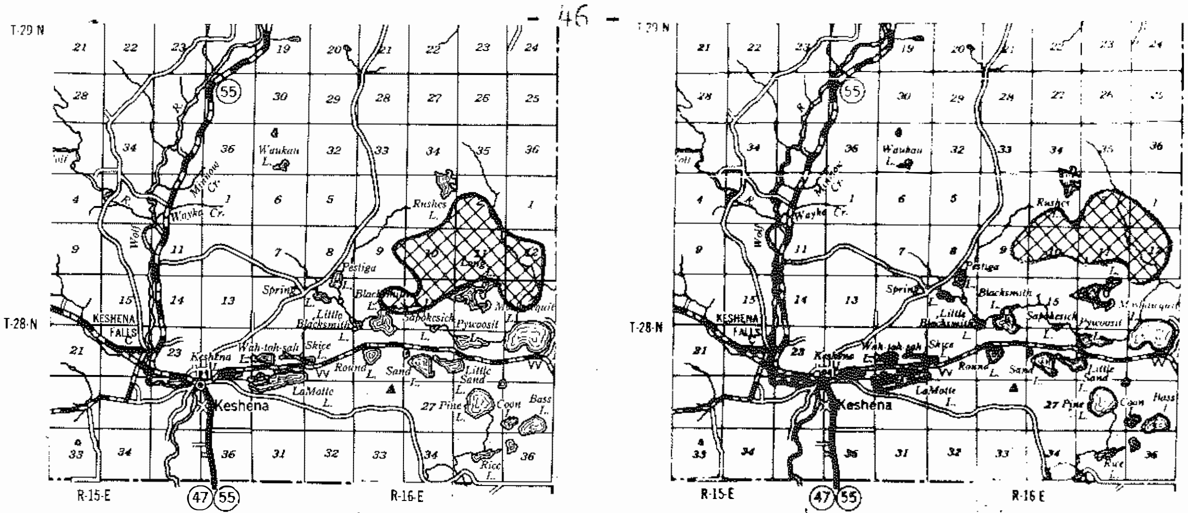
Hemlock was also examined in the Big Block in the Flambeau River State Forest (Sawyer County) on September 8, 1971. No current hemlock borer activity or tree mortality were noted.

Hemlock mortality, similar to that observed in Menominee County, was observed in parts of Sections 31, 32 and 33, T40N, R17E in Florence County during aerial surveys.

Oak Mortality - Menominee County

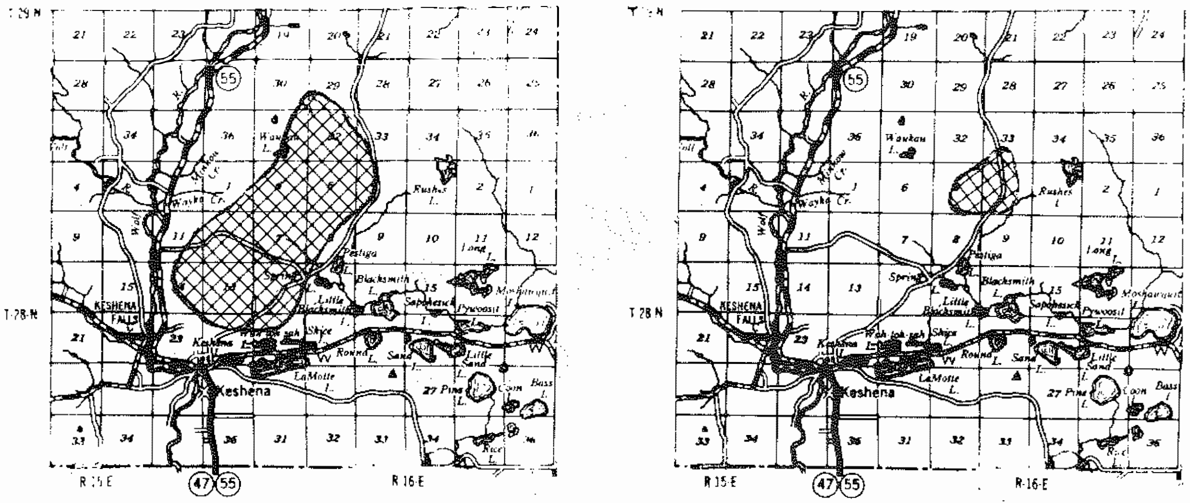
Records indicate that oak in southeastern Menominee County has been affected by a variety of adverse growth factors since the early 1950's (Figure 13). The general area has been defoliated by walkingsticks in odd-numbered years from 1955 to 1965. Severe defoliation occurred in 1961 (Figure 13A). Heavy tree mortality, attributed to the two-lined chestnut borer, occurred there during the period 1964 to 1966 (Figure 13B). The fruit-tree leaf roller caused severe defoliation in the area during 1966 and 1967 (Figure 13C). Severe drought for extended periods during the summers of 1968 through 1970 and occasional late spring frosts further contributed to the die-back and tree mortality that has occurred the past two years.

Forest land in parts of T28N, R15E; T28N, R16E and T29N, R16E, which contains a large volume of sawlog-size northern pin oak (*Quercus ellipsoidalis* E. J. Hill), is of special concern because of progressive tree mortality which was first reported in 1970. Concentrations of dead trees, sufficient to warrant a salvage cut, developed in Section 33, T29N, R16E and Sections 4 and 5, T28N, R16E. Scattered individual dead trees were common in the area around the salvage cut (Figure 13D). Although a single causal agent was not apparent, dead and wilting oaks commonly exhibited black streaking in the sapwood and numerous lesions on the roots. Young red and white pine coming up under dead oak are being killed by *Armillaria mellea* in part of the area (Figure 13E).


T-29 N
T-28-N
R-15-E
R-16-E
Keshena
KESHENA FALLS
Wolf R.
Waukau L.
Rushes L.
Long L.
Pestiga L.
Blacksmith L.
Little Blacksmith L.
Sapokesick L.
Pywoosit L.
Moshawquit L.
Spring L.
Wah-toh-sah L.
Skice L.
Round L.
Sand L.
Little Sand L.
LaMotte L.
27 Pine L.
Coon L.
Bass L.
Rice L.
Wayka Cr.
Minnow Cr.
47
55

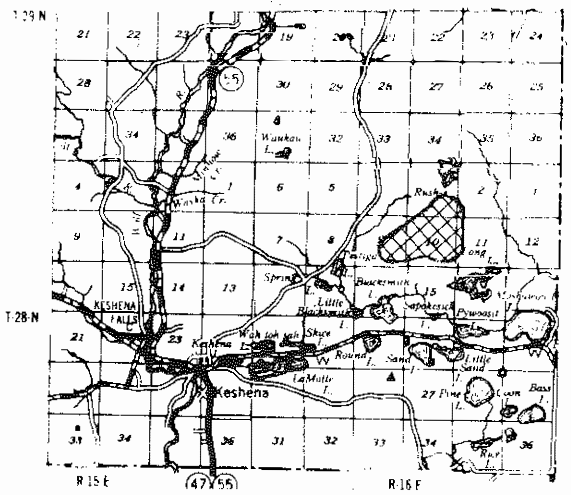
A. Severe defoliation of oak by walkingsticks - 1961

B. Oak killed by two-lined chestnut borer - 1966


T-29 N
T-28-N
R-15-E
R-16-E
Keshena
KESHENA FALLS
47
55

C. Severe defoliation of oak by fruit-tree leaf roller - 1967

D. Oak mortality - Cause unknown - 1971


T-29 N
T-28-N
R-15-E
R-16-E
Keshena
KESHENA FALLS
47
55

E. Area of dying red and white pine under dead oak overstory - 1971

FIGURE 13. Biological Events in Oak Stands in Southeastern Menominee County

Miscellaneous Fungi Collected

Aleurodiscus acerinus (Pers.) V. Hohn and Litsch. -

Collected from the bark of sugar maple, Menominee County, 6/3/71

Aleurodiscus oaksii (Berk. and Curtis) Cooke -

Collected from the bark of ironwood, Langlade County, 6/2/71

Apiosporina collinsii (Schw.) Von Hohnel -

Causing a witches'-broom on serviceberry, Burnett County, 3/26/71

APPENDIX A

Air Pollution Indicator Investigations - Rubber Strips, Tobacco, White Pine

Three techniques for determining air pollution in forest areas were evaluated by department personnel in Air Pollution Control and Forest Pest Control working with private cooperators.

Rubber strips and tobacco were used to monitor the atmosphere at several locations, and white pine sensitivity to air pollutants was investigated at Brodhead, Wisconsin in 1971 (Figure 14).

Data obtained supplemented that gathered by more sophisticated monitoring equipment from a statewide system of air sampling sites located primarily in urban areas.

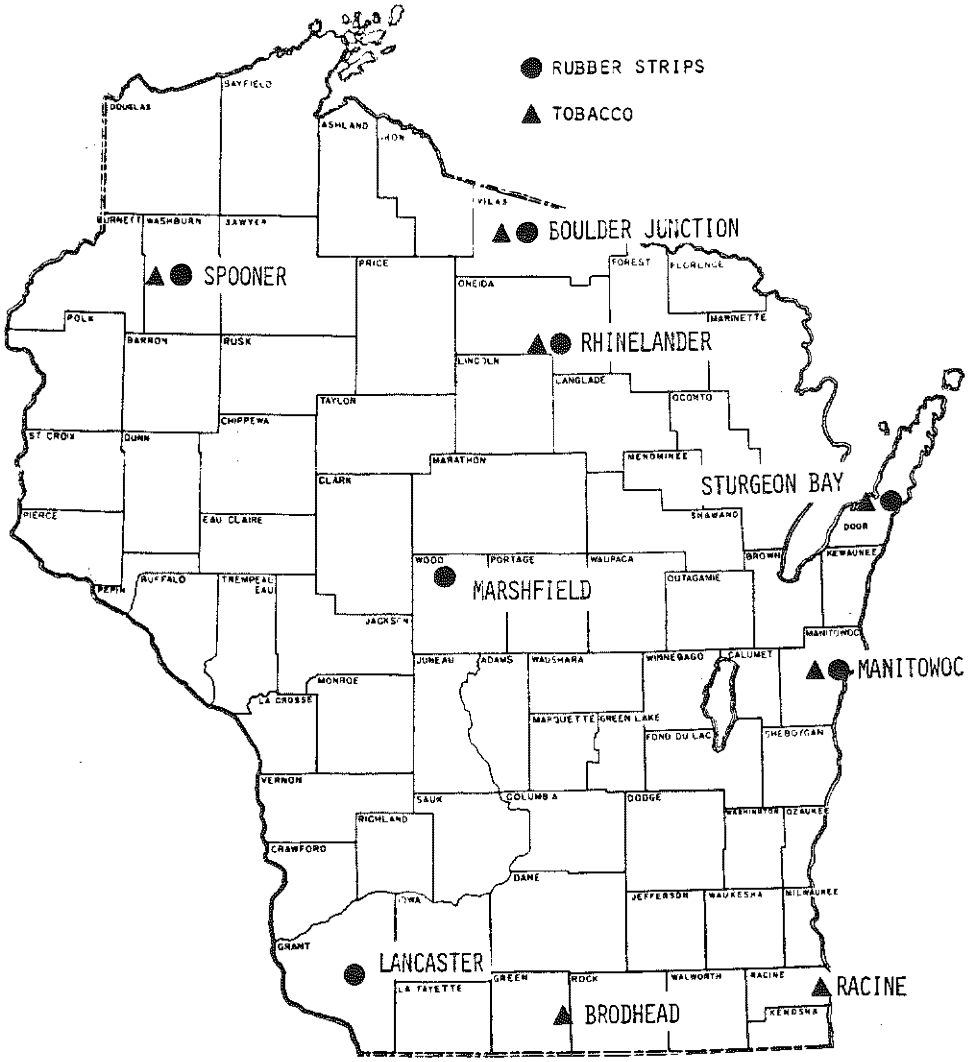

● RUBBER STRIPS
▲ TOBACCO
▲● BOULDER JUNCTION
▲● SPOONER
▲● RHINELANDER
▲● STURGEON BAY
● MARSHFIELD
▲● MANITOWOC
● LANCASTER
▲ BRODHEAD
▲ RACINE
BAYFIELD
DOUGLAS
ASHLAND
IRON
VILAS
BURNETT
WASHBURN
SAWYER
PRICE
FOREST
FLORENCE
ONEIDA
MARINETTE
POLK
BARRON
RUSK
LINCOLN
LANGLADE
OCONTO
TAYLOR
CHIPPEWA
ST CROIX
DUNN
MARATHON
MENOMINEE
CLARK
PIERCE
EAU CLAIRE
SHAWANO
DOOR
WOOD
PORTAGE
WAUPACA
BROWN
KEWAUNEE
OUTAGAMIE
BUFFALO
PEPIN
TREMPEALEAU
JACKSON
MANITOWOC
JUNEAU
ADAMS
WAUSHARA
WINNEBAGO
CALUMET
MONROE
LA CROSSE
MARQUETTE
GREEN LAKE
FOND DU LAC
SHEBOYGAN
VERNON
SAUK
COLUMBIA
DODGE
WASHINGTON
OZAUKEE
RICHLAND
CRAWFORD
DANE
IOWA
JEFFERSON
WAUKESHA
MILWAUKEE
GRANT
GREEN
ROCK
WALWORTH
RACINE
LA FAYETTE
KENOSHA

Figure 14. Locations of tobacco plants and rubber strips used to locate ozone levels in Wisconsin - 1971

Rubber strips were one means used to determine presence and quantity of ozone in the atmosphere. Standardized strips, 8 mm x 50.8 mm x 1.59 mm, obtained from the Woodlawn Rubber Company, Cincinnati, Ohio, were exposed to the atmosphere for 7 days and then were replaced by fresh strips. The procedure was repeated weekly from July through September. Strips were stored individually in tightly closed vials except for the exposure period.

During exposure, each strip was gripped at each end by an alligator clip and kept under uniform tension in a vertical position by a 360 gram weight attached to the lower clip. The strip was sheltered from the sun, wind and rain within a coffee can with the open end down (Figure 15).

The rubber strips were examined at the end of the season at 35x magnification (Figure 16) and the average depth of cracking was computed[1,2]. These values were used to indicate the relative amounts of ozone at each site.

Procedures and results of the rubber strip method for determining ozone pollution are on file at the DNR Air Pollution Control Section, Box 450, Madison, Wisconsin.

Air pollution-susceptible (Bel W-3) and resistant tobacco (Bel B and Bel C) were planted near Brodhead, Wisconsin (SENE, Section 1, T2N, R9E) on June 24 next to white pines that had needle blight in 1970. The tobacco was examined for weather fleck which is a necrotic stippling of the upper leaf surface. This occurs after exposure to ozone or sulfur dioxide. Weather fleck was observed on the newly formed leaves of Bel W-3 tobacco from July through September. However, necrotic spots were fewer and smaller on leaves that emerged between August 13 and September 17. The Bel-B and Bel-C varieties of tobacco remained free of symptoms throughout the growing season.

White pine was also used as an atmospheric pollutant indicator at Brodhead. Two trees with blighted 1970 needles were along with one healthy control tree. Polyethylene bags were placed on 5 branches of each tree on May 28. The bags were fastened so atmospheric gases such as ozone or sulfur dioxide would not come in direct contact with the needles that developed that year.

Newly emerged unbagged needles of the two previously blighted pines were yellow-orange ½" back from the tips while all newly emerging needles within the bags were green and healthy on July 17. Bagged and unbagged current year's needles on the control tree were green and healthy on the same date. On July 22, there was no additional yellowing or bending of the current year's needles on two susceptible trees, but recent weather fleck had occurred on the Bel W-3 tobacco. On September 17 the orange-colored white pine needles were tan with black fungal fruiting bodies on their surface. The needles within the bags remained green and healthy.

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[1] Cavender, James H. 1971. Interstate surveillance project: measurement of air pollution using static monitors. U. S. Environmental Protection Agency, Air Pollution Control Office, Pub. No. APTD - 0666.

[2] Vega, T. and C. J. Seymour. 1961. A simplified method of determining ozone levels in community air pollution surveys. Jour. Air Poll. Cont. Assoc. 11:28-34.

Sensitive vegetation, such as white pine and tobacco, provides an economical means of determining the presence or absence of certain air pollutants, particularly ozone and sulfur doxide. White pine is apparently susceptible only while the newly emerging needles are developing in June and July. Tobacco continues to provide fresh new leaves throughout the summer until frost kills it in the fall. Thus, plants are limited in their usefulness by their growth requirements and habits, even though they may be highly sensitive indicators. It is also difficult to obtain precise quantitative measurements of air pollutant levels from vegetation.

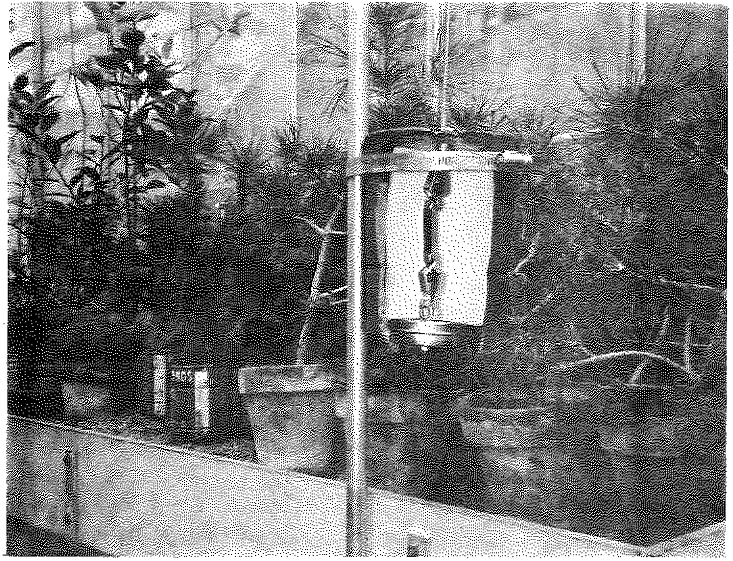

Figure 15. Shelter-can cutaway to expose rubber strip apparatus used to monitor ozone

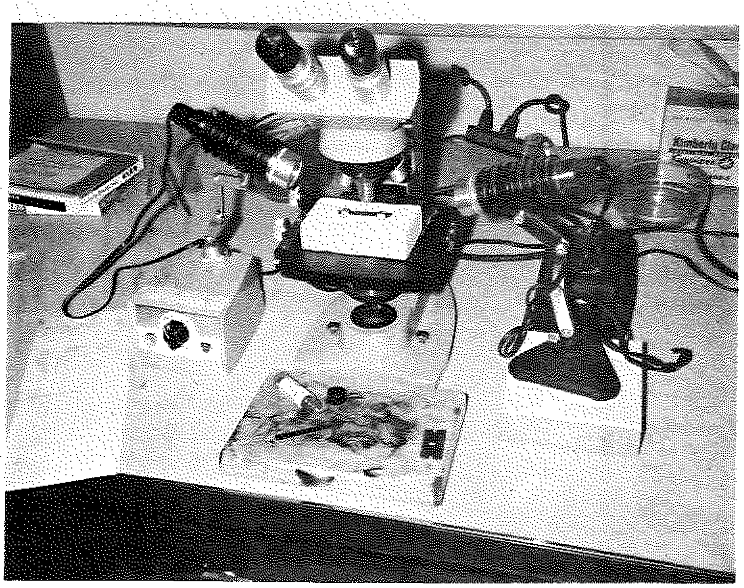

Figure 16. Rubber strip in place on microscope stage for measurement of crack depth

APPENDIX B

DYLOX ^{R} - TESTS FOR CONTROL OF THE JACK-PINE BUDWORM IN 1971

by

R. B. Stewart

Several new insecticides have been field-tested in Wisconsin in the continuing search for safer, less persistent pesticides for suppressing outbreaks of injurious forest defoliators. DYLOX^R ULV (ultra low volume) has been tested in Wisconsin against the jack-pine budworm, Choristoneura pinus pinus Freeman, with varying results. Population reduction attributable to chemical application in previous tests have ranged from 93% to 18% (Annual Report, Forest Pest Conditions in Wisconsin, Department of Natural Resources, 1967 and 1968 respectively). Tests were conducted in 1971 to evaluate DYLOX 80% S.P.A. and Dylox ULV to obtain data required for federal registration of the compound for control of the jack-pine budworm.

DYLOX ^{R} is Dimethyl (2,2,2- trichloro-1-hydroxyethyl) phosphonate. Technical DYLOX has an acute oral toxicity LD_{50} of 450-500 mg/kg (Rats), and an acute dermal toxicity LD_{50} 2000 mg/kg (rats). Additional technical information on either formulation is available from Chemagro Corporation, Kansas City, Missouri.

Two formulations of the insecticide tested were: DYLOX 80% S.P.A. in Summer Crop Spray Oil (1 pound active ingredient in one gallon), and DYLOX ULV in Panasol (1 pound active ingredient in one gallon). Applications were made with a Piper Pawnee airplane equipped with a boom assembly containing 12 Spraying Systems No. 8010 spray tips directed downward at 45° into the airstream when the plane was in level flight. Sprays were applied from an elevation of 50 feet above the forest canopy at an approximate air-ground speed of 90 M.P.H. The calculated effective swath width was 66 feet. Pressure in the spray discharge system was maintained at approximately 40 pounds by a wind-driven pump.

Two 20-acre blocks of timber were treated with each formulation. Test blocks were located in 20 - 35 year old natural jack-pine (Pinus banksiana) stands in Douglas County, Wisconsin. Larval counts were made on ten 15-inch twigs from no less than 5 trees at each of 20 stations in each test block. Stations were located 66 feet apart along a v-shaped route which crossed the line of flight twice at an angle of 45°. Pre-spray counts were made on June 28, 1971, and applications were made that same day between 6:00 p.m. and 8:00 p.m. Post-spray counts were made eight days later on July 6. Similar counts were made in a comparable untreated jack-pine stand one mile away.

Computations were adjusted for natural mortality using Abbott's formula[1]:

$$\% \text{ Population reduction} = 1 - \frac{(CB \times TA)}{(CA \times TB)} \times 100$$

CB = Check, total larvae before treatment
CA = Check, total larvae plus pupae after treatment less total pupae before treatment
TB = Treatment, total larvae before treatment
TA = Treatment, total larvae plus pupae after treatment less total pupae before treatment

RESULTS

DYLOX 80% S.P.A. (1.0 pound AI per gallon in Summer Crop Spray/Oil per acre intended rate) was applied at an actual rate of 1.05 gallons per acre. A light breeze from the west caused a slight drift of spray to the east when spray application started along the west side of the block. This resulted in deficient insecticide coverage on the first two and last two sampling stations on the west side of each treated block. Below are two sets of computations for the DYLOX 80% S.P.A., one uses data from all stations in the treated blocks, and the other eliminates stations that were missed because of excessive drift.

1. All sampling stations:

$$PR = 1 - \frac{(544 \times 185)}{(453 \times 506)} \times 100 = 56.1\% \text{ Population Reduction}$$

2. All sampling stations less 8 stations along west edge of blocks:

$$PR = 1 - \frac{(413 \times 113)}{(360 \times 403)} \times 100 = 67.9\% \text{ Population Reduction}$$

DYLOX ULV (1.0 pound AI per gallon in Panasol/acre intended rate) was applied at an actual rate of 0.87 gallons per acre. Adjustments were made in the field to compensate for the westerly air movement so that all sampling stations were treated.

1. Using data from all sampling stations:

$$PR = 1 - \frac{(544 \times 136)}{(453 \times 405)} \times 100 = 59.7\% \text{ Population Reduction}$$

CONCLUSIONS

A budworm population reduction of 75% to 80% from insecticide application is considered adequate to prevent serious defoliation and top killing of jack-pine. Neither formulation of DYLOX achieved this reduction in the tests.

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[1] Abbott, W. S. A method of computing the effectiveness of an insecticide. Journ. Econ. Ent. 18: 265-267. 1925

However, unfavorable weather conditions might have adversely influenced the results. Heavy thundershowers drenched the area about six hours after spraying, and intermittent light to heavy rains continued to fall on the blocks up to 36 hours after application. Under better field conditions, DYLOX could possibly achieve acceptable control.